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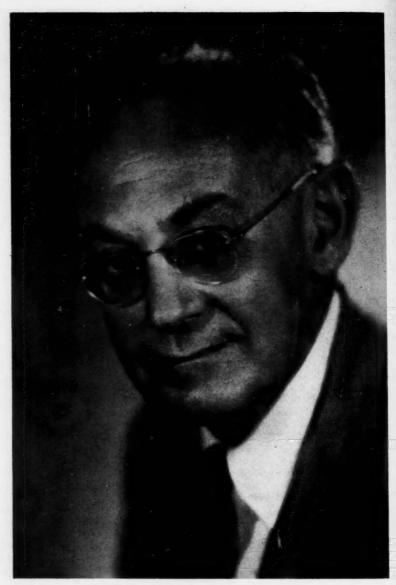
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## **FELLOWS**

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## AMERICAN FARM ECONOMIC ASSOCIATION



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MORDECAI JOSEPH BRILL EZEKIEL

MORDECAI JOSEPH BRILL EZEKIEL was born in Richmond, Virginia, May 10, 1899. In 1918 he completed his B.S. degree in agronomy and general agriculture at the Maryland State College of Agriculture (now University of Maryland); and in the same year he entered the United States Army as a 2nd Lieutenant of Infantry.

Following three years of experience with the Census Bureau, beginning in 1919, he joined the Bureau of Agricultural Economics (BAE) and remained there during its formative, and in many respects most fruitful and even glorious, years. In snatched intervals he completed work for his M.S. at the University of Minnesota in 1923 and for his Ph.D. at the Robert

Brookings Institution of Washington in 1926.

While with BAE Mordecai Ezekiel contributed notably to the development of statistical theory and techniques in price analysis, culminating in his now classic *Methods of Correlation Analysis*, published in 1930. Then and later he authored a continuous flow of technical articles and publications. Also teaching at the U. S. Department of Agriculture graduate school, he attained true eminence of scholarship both in agricultural economics and in general economics as well.

Scholar though he was, Moredcai Ezekiel never regarded economics as an abstract science, and he never climbed the winding stair to an ivory tower. For him economic knowledge was a living part of the real world. He has repeatedly lent his talents and limitless energy to public action which he believed to be directed toward the welfare of men. He has not

feared to join pioneering efforts.

He was assistant chief economist of the Farm Board from 1930 to 1933. As economic advisor to the Secretary of Agriculture from 1933 to 1941, he aided in preparing the Secretary's speeches and reports and in drafting legislation and guiding policies for the Agricultural Adjustment Administration. For a time during the war he served as executive assistant to Charles E. Wilson, vice-chairman of the War Production Board. After returning to BAE he prepared economic material relating to postwar reconversion; and in his exploratory studies of rural industry he anticipated rural development a near-decade before a program was introduced.

Since 1946 Mordecai Ezekiel's compass has been international, and his reputation world-wide. As a member of the Food and Agriculture Organization of the United Nations (FAO) he has contributed to such international programs as those for improvement of underdeveloped areas, and was a member of missions to Greece in 1946 and Poland in 1947. And as deputy director of the economics division of FAO since 1951 he has cosponsored a veritable bureau of agricultural economics for the world.



OSCAR B. JESNESS

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O SCAR B. JESNESS was born in Stevens County, Minnesota, in 1889. He received his collegiate training at the University of Minnesota where he earned his B.S. degree in 1912, his M.S. in 1924, and his Ph.D. in 1928.

Dr. Jesness has served as a pioneer spokesman in the development of agricultural economics, and has added immeasurably to the stature of this relatively young profession. His interest in teaching, research, and public service has been broad, encompassing many phases of agricultural economics, including agricultural policy, marketing, cooperation, farm finance, land economics, and foreign trade. He has led with insight and enthusiasm the programs of numerous local, state, and national groups and committees concerned with the problems of rural people.

From 1915 to 1920, Dr. Jesness was a specialist in cooperative organization for the U. S. Department of Agriculture. His administrative talents have helped shape and guide the development of two university departments of agricultural economics; he was head of the department at the University of Kentucky from 1920 to 1928 and at the University of Minnesota from 1928 to 1957. He is the author or co-author of four books and has also written over 400 bulletins, pamphlets, and articles relating to farm

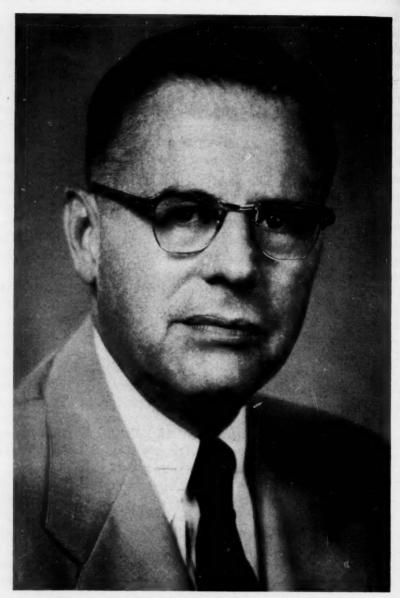
problems.

His nonacademic career has been equally distinguished. He has served as economic adviser and counselor to many different government agencies and other groups interested in public affairs. In 1956 he was appointed by President Eisenhower to a three-year term on the National Agricultural Advisory commission. He has served on important committees of the U. S. Department of Agriculture, the Association of Land Grant Colleges and Universities, American Bankers Association, Committee for Economic Development, U. S. Chamber of Commerce, Minneapolis Grain Exchange, American Association of University Professors, and innumerable other groups. He served as a consultant to the Randall Commission on Foreign Economic Policy. He is a member and deputy chairman of the board of directors of the Federal Reserve Bank of Minneapolis.

An active member of the American Farm Economic Association for many years, Dr. Jesness served as its president in 1937. From 1933 to 1935 he was editor of the *Journal of Farm Economics*. He is a member of the International Conference of Agricultural Economists and has served as a

member of its U.S. council.

In the 45 years of his professional career Dr. Jesness has contributed most significantly to modern agriculture, to agriculturally related businesses, and to institutions of higher learning as an ardent scholar, diligent researcher, able administrator, faithful adviser and counselor on the economic problems of our society. Dr. Jesness has rendered a distinctive service to the profession of agricultural economics by his establishment of high standards of achievement, by the vigor of his critical influence, and by his scholarly convictions.



WILLIAM IRVING MYERS

ILLIAM IRVING MYERS was born in Lowman, Chemung County, New York, in 1891. He received his B.S. degree in 1914 and his Ph.D. in 1918 from Cornell University. After graduation in 1914, he became a staff member at Cornell and has remained at that institution since. Starting as instructor in farm management in 1914, he became assistant professor of farm management in 1918, and professor of farm finance, a title which he still holds, in 1920. He was advanced to head of the department of agricultural economics in 1938 and to dean of the College of Agriculture in 1943.

Because of his keen insight and outstanding administrative ability, he was called in 1933, to become deputy governor of the newly created Farm Credit Administration. Later in the same year, he was appointed governor, and continued in that position until 1938. During this five-year period he was on leave from Cornell. As governor of the Farm Credit Administration, Dr. Myers guided the development and directed the operation of the largest farm mortgage lending operation in the history of our country, and supervised the organization of the production credit

system and the banks for cooperatives.

A stimulating lecturer and sympathetic counselor, "Bill" Myers was highly popular with the students on the Cornell campus during the period that he taught, from 1918 to 1933. Much of his time was spent working with graduate students. He made substantial contributions in editing and revising the first research efforts of these students. Others in similar circumstances might have permitted their names to appear on the final publication as senior author, but characteristically Bill Myers' name appears

only in footnotes of acknowledgement.

The wealth of his knowledge and his sound judgment have caused many to seek his services as director, trustee, and member of boards, commissions, and committees. A few of the positions he has held are: deputy chairman of the board of directors of the Federal Reserve Bank of New York, 1943-54; chairman of the board of trustees of the American Institute of Cooperation, 1944-48; trustee of the Rockefeller Foundation and the General Educational Board, 1941-57; and chairman of President Eisenhower's National Agricultural Advisory Commission from 1952 to date. Truly, a distinguished career in public service!

His achievements have brought him many richly deserved honors. One of the more notable honors was received in 1938, the American Farm Bureau Federation Award for distinguished service to organized agricul-

ture.

Bill Myers served the American Farm Economic Association as secretary-treasurer from 1927 to 1931 and was honored by being elected president in 1934.

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#### THE IMPACT OF SCIENCE ON AGRICULTURE\*

R. G. Bressler. Jr. \*\*
University of California, Berkeley

THE THEME of this annual meeting of the Canadian Agricultural Economics Society and the American Farm Economic Association is "Meeting the Challenge of Science in Agriculture." During the next three days we will be privileged to hear more than a half-hundred of our colleagues present or discuss papers directly related to this central theme. The general sessions will trace the contributions of the physical, the biological, and the social sciences to change, to economic growth and development. Section meetings will consider scientific progress in agricultural production, in human nutrition, in food technology and food distribution. Papers will be devoted to such diverse aspects as productivity, agricultural adjustment, farm income and prices, market structure and industry integration, the family farm, social structure and political power, value judgments and human welfare. For this play of many acts and actors, the present paper serves as prologue.

To set this stage, I have elected to speak generally of the role of science and of innovation in our society and economy. Many of the papers that follow will deal with specific aspects of the impact of science on the agricultural economy. Here I ask you to consider the total economy and the total problem of economic growth and development, where agriculture is only a relatively small segment of the whole. In this setting, we will view research and science as a productive activity, and consider the magnitude and source of support for this important "industry." Finally, I will conclude my paper by expressing some personal judgments on the need for continued research related to agriculture. I do this deliberately,

Giannini Foundation Paper, Number 171.

<sup>\*\*</sup> Address of the President-Elect, American Farm Economic Association, August 20, 1958.

for there may be some whose real concern for the short-run welfare of agriculture in the United States and Canada may blind them to the general benefits of increasing knowledge for all of society—here and through the world. Meeting the challenge of science in agriculture means using the knowledge obtained through science for the general welfare—not "protecting" agriculture against technological advance.

## Scientific Progress and Economic Growth

It is at least approximately correct to state that man lived in a subsistence economy for many, many centuries—an economy based predominantly on the ability of the individual or at most the small community to produce those items that constituted the content of living. Economic organization was centered on subsistence agriculture with its attendant family processing and manufacture. Some specialization in the form of crafts and trades emerged, but again this was largely contained within the local economy of a village. Interregional or even "world" trade existed, but this was confined to a few essentials such as salt or to exotics such as silk and spices—items that affected the average family in very minor degree. The early explorations of the 15th and 16th centuries were based in part on the desire for favorable trade routes to the fabulous East Indies for these exotic items, plus the everpresent lure of gold and jewels.

The beginnings of the industrial revolution put a different face on matters, and soon had a dominant influence on exploration and colonization. This was most effectively recognized by Great Britain. Under the mercantilist philosophy, colonies were sought to round out supplies of raw materials and to guarantee overseas markets within largely self-sufficient empires. British long range policies, therefore, contemplated several stages of colonial development: (1) the establishment of outposts for exploration and experimentation; (2) the shipment of readily obtained native materials such as fish, furs, herbs, minerals, and naval stores; (3) the settlement of agricultural communities to produce such products as sugar, wine, hides, and dyes; (4) the further development of industries based on forest and mineral resources; and (5) the eventual creation of a significant market for British manufacturers, especially woolen goods, among the colonists and the native populations.

The fact that this concept of an industrialized mother country with rawmaterial oriented colonies eventually was abandoned, need not concern us here. What is significant is that, even as recently as 1850, the North American economies had evolved little beyond the subsistence organization which had characterized man's economic efforts for many centuries. The frontier of settlement had been pushed inland from the Atlantic seaboard to the Great Lakes district and the Mississippi Valley, with small beachheads in California and the Northwest. At the beginning of the farm Ye logic indu fact emp

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19th century, only 6 per cent of the population of the United States lived in urban communities with population in excess of 2,500 inhabitants; perhaps 90 per cent of total gainful employment was in agriculture. By 1850, rural population still accounted for 85 per cent of the total, while farming provided gainful employment for two out of every three workers.

Yet science and invention had already provided the essential technological base for a rapid development of economic specialization. The industrial revolution had developed the "know-how" for factory manufacturing, and these "infant" manufacturing industries were providing employment for one-sixth of all gainful workers. The beginnings of scientific farming were at hand in the form of increasing knowledge of plant and animal breeding, pest control, crop rotations, and mechanization. Transportation technology had greatly advanced, and at least a start had been made in the development of an effective transportation system: some 75,000 miles of surfaced roads; a system of canals and inland waterways which, though soon to be superseded, provided important low-cost links from the Midwest to the Atlantic Coast; the first 9,000 miles of a rapidly expanding railroad network. A low-cost and dependable mail service was available, the telegraph had been invented and commercial lines connected New York with Chicago and Wahington with New Orleans.

In short, a century ago the North American economy was still dominated by subsistence agriculture, but stood on the threshold of rapid developments in industry and in commercial and specialized agriculture. The technological base was available for the growth of industry with its accompanying urbanization of the population. The technological base was available for a commercial, specialized agriculture to supply food and fiber for the industrial economy. The technological base was available for the net works of transportation, communication, and marketing needed to tie together these industrial and agricultural sectors of the economy into a highly dynamic market-oriented enterprise economy.

I need not bother you with details of the growth and evolution of the past 100 years. Suffice it to say that at present in the United States about 40 per cent of the population lives in rural communities, 12 per cent of gainful employment is in agriculture, and farming and other primary industries account for only 7 per cent of the national income. Secondary or manufacturing industries now originate 38 per cent of national income, distribution industries about 33 per cent, service occupations 10 per cent, while the operations of federal, state, and local governments contribute the remaining 12 per cent.<sup>1</sup>

<sup>&</sup>lt;sup>1</sup>Data for 1955, from Statistical Abstract of the United States, 1957, U. S. Department of Commerce, p. 300.

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This was a century of tremendous increases in the physical output of the United States economy. Studies by the National Bureau of Economic Research indicate that commodity production increased from an index of 31 in 1869 to 443 in 1949 (with 1899 base equal to 100).2 In the same period, total employment in commodity production and distribution increased from an index of 44 to 178, while population moved from an index of 52 to 199. As a result, productivity as measured in terms of output per man more than tripled, from an index of 70 to 249, while the real standard of living as measured by per capita commodity production increased from 60 to 223. These comparisons understate the increases in living standards; the average person now begins his work career at a later age and has more leisure as a result of a 20 per cent decline in the length of the work week. Moreover, the content of living is not limited to real goods, and the United States has been providing itself with more and more personal and professional services. Certainly, science and technology have moved us far from the situation where the struggle for mere subsistence dominated the use of all resources.

I will not dwell on these increases in productivity and levels of living, important though they be. Rather, I want to stress that the direct impact of knowledge, of science and invention, and of technological advance on our economy-and so on agriculture-was to free us from the yoke of subsistence production. Science told us how to improve farming practices. how to machine metals, and how to manufacture industrial products. But most of all, science permitted the development of a specialized enterprise economy. And this was essential if the potentials of more efficient agriculture and industrial production were to be achieved. Science changed the homesteader of the plains and prairies to a wheat farmer. Science took the farmers's son out of the hay field and put him in the petroleum plant, and his daughter from the garden and canning kettle to the factory or office. Science made agriculture a business, not a relatively low-paying way of life. Science saved the American farmer from agrarian peasantry, and gave his children the opportunity of higher education and so the right and freedom to compete in any occupation.

## Science, Technology, and Stagnation

I have already stated that I will not dwell on the impact of science on productivity and productive capacity—many of the papers that follow will trace these effects with greater authority than I can command. Let me turn, therefore, to a less obvious and often overlooked aspect as I join Slichter in pointing out the equally important effects of technological

<sup>&</sup>lt;sup>2</sup> Harold Barger, Distribution's Place in the American Economy Since 1869, National Bureau of Economic Research, Princeton: Princeton University Press, 1955.

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growth on demand.<sup>3</sup> A quarter of a century or more ago the slowing of the rate of population increase coupled with the fairly complete "occupation" of resources—and especially the disappearance of the agricultural frontier—gave rise to the "stagnation thesis." It was pointed out that the total economy, like a business in an expanding market, found it reasonably easy to expand with the twin stimuli of population growth and the exploitation of boundless natural resources. Without these stimuli, however, consumption expenditures were expected to lag behind productive capacity, while the resulting excess of savings over investment was expected to exert a chronic depressive effect on the economy.

It is common to point out that the American economy recovered from the depression of the 1930's in part because of the abnormal demands and investment opportunities growing out of World War II. In the period after the war, most of us anticipated substantial curtailment if not severe depression. It was generally supposed that the private sectors of the economy would not be able to take up the slack created by the curtailment of government-financed war production. In short, we doubted the ability and willingness of the American public to consume at levels consistent with post-war production capacity. The extent to which this doubt was justified is difficult to assess. Certainly the American economy received a substantial postwar impetus from the accumulated backlog of demand for consumer goods, as well as from the rehabilitation requirements of war-torn Europe. The Korean conflict and the "cold" war have maintained defense expenditures at levels well above any theoretical "peace-time" norms.

In spite of this, it is clear that the impact of technology on demand and on investment has been a major factor in recent economic growth—that the new frontier of technological advance has taken over some of the stimulating role previously played by the extensive development of natural resources. Science and technology give rise to an ever increasing array of new and improved products, and these new products increase our propensity to spend and consume. This means investment opportunities for industry, and so further stimulation and growth. At the same time, technology gives rise to new methods, processes, and machines, and so again provides the incentives for new investments. Economists have devoted little time to the economics of obsolescence in producer and consumer goods. A common view is that a rapid turnover—due to style changes or new and more efficient processes—is wasteful of resources; that we throw away our hats, automobiles, or machine tools while they are still serviceable. This may be true, but to appraise such problems

<sup>&</sup>lt;sup>a</sup>Sumner H. Slichter, "Technological Research as Related to the Growth and Stability of the Economy," Conference on Research and Development and Its Impact on the Economy, National Science Foundation, Washington, D.C., May 20, 1958.

without recognition of the growth impact on the economy is a serious error.

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To conclude this section, I re-emphasize that science and technological change have an important effect on growth through their influences on consumer demands and on investment opportunities. This influence has been most pronounced in the American economy during the past quarter-century—a circumstance most fortunate in view of the long-term tendency for population growth to slow down and the more complete development of natural resources. Whether or not this growth stimulus on demand and investment will be adequate to keep pace with productive capacity is a moot question. The stagnation theorists were not wrong; like Malthus, their analyses were partial in neglecting or underestimating the potentials in technological advance. Perhaps they will be more right than wrong in the long sweep of time.

## Science-A Productive Activity

It is natural for economists to view science, or more specifically, research and innovation, as productive activities involving in the small the combination of factors of production and in the large the allocation of resources. Research does involve inputs, and these inputs are diverted from alternative uses. Research also involves outputs of knowledge. We may properly view the process as the most important form of capital formation, where resources are withdrawn from immediately productive uses and devoted to other uses designed to increase productive capacity at some later date.

Research differs from other forms of production primarily in the risk and uncertainty surrounding the ultimate output and even here we may agree that the uncertainty differs only in degree from that found in many long-run investments or in the agriculture of certain regions. There seems to be a growing tendency, however, to forget or minimize this uncertainty—perhaps because the public has been over-impressed with the success of the massive atomic projects. We remember Edison and Kettering, and easily forget the thousands of inventors whose efforts were largely unrewarded. We remember the gusher and forget the dry hole. We honor our Men of Science and Nobel Prize winners, and neglect their equally competent colleagues who have never been fortunate enough to make a strategic breakthrough.

The essence of research is to search the unknown, and uncertainty as to the time or degree of success is characteristic of this endeavor. Uncertainty of output is compounded by uncertainty of application and of payoff because the knowledge resulting from research is largely a producer-good rather than for direct consumption. This uncertainty is extreme in basic research and the search for fundamental knowledge; it is

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much less but still important in the exploitation that follows a major breakthrough or in the improvement and development of new products. This differential risk has an important impact on the financing of research and on the types of research undertaken.

Estimates of the National Science Foundation indicate that some \$9.9 billion were spent on research and development in the United States during 1957-about equal to one-fifth of all capital expenditures for industrial structures and equipment.4 This total was divided as follows: government agencies, \$1.4 billion; educational institutions and other nonprofit organizations, \$1.2 billion; industry with federal government financing, \$3.5 billion; and industry with its own funds, \$3.8 billion. Thus one-half of the total was financed by the federal government, and with allocations based primarily on military objectives or international prestige. The 40 per cent representing industry research supported by industry funds was motivated primarily by economic considerations research investments in the anticipation of more or less immediate profit or payoff, and no doubt influenced by profits and income taxes. For reasons of uncertainty already mentioned, most of this private research is in such relatively "sure" areas as product improvement and product development. Basic research by industry represents only 5 per cent of the total industrial research budget.

The social sciences are obviously of interest to agricultural economists, and you will not be surprised to discover that support for research in this field has lagged far behind the support for the physical sciences. Federal spending in support of social science research amounted to less than 4 per cent of the total governmental outlay for science in 1957. The National Science Foundation has been increasing its support of the social sciences, but devoted only about 2 per cent of its grants to this field in the same vert.

To sum up, research has been a rapidly growing industry in the United States, both because of massive governmental support for military purposes and of the growing realization by private industry of profits from research investments. Industrial research has been primarily in such areas as product improvement and development. Expansion of private research is inhibited by the uncertainty of profitable results, and also by the difficulty of restricting the payoff to the individual firm that made the research investment. In any case, it is clear that the high-risk areas of basic research are being neglected both by government and industry. Some of these areas might be exploited by industry-wide support for re-

<sup>&#</sup>x27;Martin R. Gainsburgh, "Allocation of Resources to Research and Development," Conference on Research and Development and its Impact on the Economy, National Science Foundation, Washington, D.C., May 20, 1958.

search, but for the most part the social gains potential in heavy support for research must be achieved through the channeling of public funds to these research areas. Much the same is true for social science research; while such areas as market research and development are being pushed on a private payoff basis, most areas of social science research will be expanded only through increased support by universities and the government.

Because of the uncertain nature of the production function for research and the indefinite but most important connection between research results and economic growth, it is impossible to devise a simple, rational basis for judging or planning the allocation of resources to this sector. It is clear that society could devote too large a portion of its resources to research just as our prehistoric ancestors might have spent so much time in perfecting his tools and weapons that he neglected to spend enough time in hunting and planting crops. Does the expenditure of \$10 billion for research represent an optimum allocation of resources for the United States? More important, does the outlay of well under \$1 billion for basic research plus all social science research represent any meaningful marginal calculation? While these questions cannot be answered precisely, there appears to be a general concensus that our society would benefit from much larger investments in science and research. Certainly the allocations to this sector have expanded rapidly during the past decade and promise even greater expansion in the future. Industry has learned that research can be a profitable business, and there is little doubt that private research will continue its rapid expansion. But there is every reason to fear that the future growth of research will emulate the past in its neglect of basic or fundamental research. This is especially true in the United States, where one of our strong fortes has been the rapid and efficient exploitation of fundamental research findings of scientists in other nations.

My personal conviction is that the American economy, Canada and the United States, must continue to step up the support of research, and especially that we should increase basic research. In the hope that we will find better ways to utilize the results of reseach in the natural sciences, I trust that there will be increased support for the social sciences. Since basic research and social science research do not have obvious and immediate connections with private industry profits, such increased support must come largely from the government and from the universities. Within the government area, attention is also focused on immediate objectives and fast payoff, so that there will be an important task of educating the public and the public representatives to the long-run importance of research in these neglected fields.

An important aspect of the optimum allocation of resources to research

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is that knowledge feeds and grows on knowledge. Every increase in knowledge sets the stage for still greater advances, by narrowing the gaps that must be bridged by creative imagination. Usher emphasized the importance of the stage-setting in mechanical invention. Here progress has often taken the form of the gradual accumulation of bits of information until the stage was set, then the spark of creative imagination bridged the gaps by strategic syntheses and the resulting breakthrough permitted a rapid acceleration in the rate of growth and development. Slichter also points to this characteristic of research, noting that "... the greater the body of existing knowledge, the greater is likely to be the value of new discoveries ...," and that an increase in research and in knowledge "... does not tend to reduce the marginal value of its product; on the contrary, it tends to increase the marginal value. ... Unlike other industries, the industry of discovery produces against a rising schedule of marginal utility, not a diminishing schedule."

## Agricultural Research and Agricultural Surpluses

The dilemma of large public expenditures for the control of agricultural surpluses and the simultaneous increasing public support for agricultural research is immediately beneath the surface of the theme for this meeting, and will be the direct subject of some of the papers to follow. It is certainly true that scientific research and invention have greatly expanded the productive capacity of American agriculture, and there is no reason to suppose that this expansion will not continue in the future. It is equally certain that American agriculture is producing an aggregate surplus over domestic requirements and normal exports at present, although the magnitude of this aggregate surplus may be smaller than some suppose, and that such surpluses will continue for some time in the future. These facts have given rise to the suggestion that output-increasing research should be curtailed, that surplus control and price-income support be achieved through a deliberate slowdown in the progress of knowledge.

My thoughts on some phases of this problem are on record, and I will not repeat them here. Nevertheless, it seems to me important that this annual meeting start its consideration of the impact of science on agriculture with at least reference to certain aspects of the broad problem. The following comments and personal value judgments are given in near-outline form.

<sup>&</sup>lt;sup>6</sup>A. P. Usher, *The History of Mechanical Invention*, Cambridge: Harvard University Press, 1954, revised edition.

<sup>&</sup>quot;Slichter, op. cit., page 4.

"R. G. Bressler, Jr., "Farm Technology and the Race with Population," Journal of Farm Economics, November, 1957, pp. 849-864.

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1. Research in agriculture, as in other fields, is uncertain with respect both to the timing and the importance of the knowledge-output. To restrict research is thus to gamble with a most uncertain future. It seems highly probable that our current wheat surpluses could be dissipated within a few years, for example, if we prohibited all research on rust-resistant varieties. It is far less certain that we could then reinitiate the research with positive assurance of the desired level of control or that we can stay ahead of the rapidly mutating fungi even with constant effort.

2. Even if it were clear that agricultural technology would more than keep pace with domestic and foreign needs for food and fiber, given our present allocation of resources to agriculture, it does not follow that a restriction on the growth in agricultural productivity is socially desirable. The essence of the rapid expansion of the American economy has been technological advance and the shift of resources among alternative useswitness the diminishing relative importance of agriculture as a source of gainful employment. A policy of restricted development or application of knowledge to protect industries from technological advance would have meant a decadent economy, perhaps still characterized by the horse and buggy or the Model T, by small cities and small industries, by hand labor rather than mechanization. It may be argued that this would have meant a more peaceful and contented society. I am not convinced that Americans would consider this more important than an increasing real standard of living, or that more aggressive nations would have permitted the continuation of this peaceful, pastoral society.

3. If output-increasing public investments in agriculture must be curtailed, I submit that wise policy would be to press on the research frontier as strongly as possible, and to make curtailments by abandoning land development and improvement programs and restricting expenditures now designed to inhibit rather than encourage production adjustments. This judgment is not based on a lack of appreciation of the contributions of reclamation to the productive capacity of agriculture. Rather it reflects the belief that the results of such activities are far more certain and predictable than the results of research, and so can be drawn on readily if and as required in the future. It also reflects some personal opinions of time preference in developing exhaustable resources—for example, the silting of dams.

4. If agricultural output must be curtailed by restriction on the growth of productivity, wise policy would call for restriction of application rather than restriction of research. Effective control of output might readily be obtained by prohibiting or limiting the purchase and use of fertilizer, for example. I do not claim that this would be socially desirable, but only that it would be superior to a policy of restriction on research.

5. The above remarks do not imply that rapidly advancing technology

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does not pose problems in agriculture and in other sectors of the economy. Many of these problems constitute the need for expanded research in the social sciences. More specifically, the agricultural economist and his colleagues can contribute fundamental knowledge on the optimum organization, size, and integration of farms and marketing firms; on the resource allocation problems within agriculture and between agriculture and other sectors of the economy; and on the means by which society can modify old and outmoded institutions to take full advantage of the potentials provided by science.

## Summary

To conclude, I repeat some of my earlier statements. The prime impact of science on agriculture and on the whole economy has been that the growth of knowledge has permitted the rapid development of economic specialization and of a dynamic enterprise economy. This specialization, coupled with technological advance, has meant a tremendous expansion in the productive capacity of the economy, and so in real living standards. At the same time, the proliferation of new and improved products, new machines, and new processes has meant stimulation of consumer demand and investment opportunities. These effects have been and will continue to be of great importance in creating conditions favorable to economic growth. Agriculture has contributed to and profited from the growth of specialization and of productivity. It will continue thus to participate in the future—but not on the basis of policies designed to curtail technological advance and inhibit the adjustment of agriculture as an important sector of a dynamic economy.

#### SCIENTIFIC AGRICULTURE AND HUMAN WELFARE

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Andrew Stewart\*
University of Alberta

THE REQUIREMENTS for your speaker today (as I learned from an early draft of the program), called for "a prominent Canadian leader in economic thinking, either as a professional economist or a public official." I cannot claim to meet the prescription in any particular respect. Professional economists would be reluctant to be represented by a university president and a university president is reluctant to represent himself as a public official. Canadian economists would be unhappy-and so would I-if you were to conclude that the demonstration you will receive today represents the best in economic thinking in this country. My tools of economic analysis suffer from disuse and obsolescence, and I suspect that the experiences to which I have been exposed as an administrator and in public service have had their effect on my judgment, and perhaps on my scale of values. I recognize a developing strain of pragmatism in my philosophy which would be repugnant to many economists. I have come to accept the conclusion that "half a loaf is better than no bread," and to believe that if you can acquire the half-loaf or something better on most occasions, this is a significant degree of accomplishment. I would view with more than mere indulgence the decision-maker who, confronted with the normal range of alternatives, chooses toward the correct end of the spectrum, say 75 per cent of the time. This is my modest contribution to the theory of choice. I am impressed with the extent to which human objectives are conflicting, and am satisfied that there are no solutions to particular problems. Practical advance means that, in terms of the totality of objectives, decisions and action have resulted in a somewhat higher net level of achievement. I have a growing appreciation of the functions of the politician, and of the important role he plays in social processes. It was suggested that I treat the general area of subject matter, which is the theme of this conference, with emphasis on "international relations and the cognizance which must be given to scientific and agricultural developments in arriving at trade and other policies conducive to mutual prosperity in a peaceful world." The terms of reference call for a consideration of relations between scientific and agricultural developments, trade and other policies, mutual prosperity, and a peaceful world. I accepted the assignment within the title "Scientific Agriculture and Human Welfare." In dealing with the relations prescribed I look first at mutual prosperity and a peaceful world, both of which may be viewed as

Address given by President of University of Alberta, August 22, 1958.

ends in themselves. The second part of the paper contains some observations about science and technology, and their impact on economic growth in the industrial and agricultural sectors of the economy. In the third part, I turn to policies, and, for reasons which will be indicated, discuss the policy of economic aid related to excess capacity in agriculture.

## What Is the Nature of the Relation between "Mutual Prosperity" and "A Peaceful World"?

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A peaceful world is not only an end. We must assume that the alternative to a peaceful world is total destruction; and that peace is a necessary condition of prosperity. But is mutual prosperity conducive to a peaceful world? The answer seems less clear and may depend on what we mean by mutual prosperity. (You will notice that I define prosperity in terms of economic growth, and the advancement of real incomes. I do not extend the discussion to consider the quality of prosperity.) In terms of any acceptable measure of prosperity we can recognize three groupings in the world today-the geographically dispersed countries, dominated by western traditions, and living within the orbit of the United States; the solid land mass of the USSR and its peripheral satellites; the emerging entities of the East. Within each group there are substantial differences in the level of prosperity between the political units; there are also significant differences between the groups. I do not suggest that the growth of prosperity will alone be enough to insure world peace; but some conditions, consistent with the concept of mutual prosperity are more likely to contribute, or are likely to contribute more, to world peace than are others. The conditions of mutual prosperity which would contribute most to a peaceful world would be those in which the rates of advance of prosperity were inversely related to the prevailing levels. If this be so, then on these grounds we should be gratified by the advances which the USSR is making in its own way (which is not ours) and by its own efforts (to which it doesn't ask us to contribute) in raising the prosperity of its people; and we should, even at some cost in the rate of our own advances, be concerned to speed the efforts of the underdeveloped countries to lift their peoples from their present levels of relative poverty.

It may be that we are confronted here with the dilemma of conflicting objectives. Because of our own evaluations which place freedom of choice of the individual high up in the hierarchy of ends, we are prone to assume too readily that freedom of choice is equally effective as a means toward prosperity under all circumstances. Economic growth from which higher levels of prosperity are derived depends on the rate of investment and the adoption of improved techniques. But when freedom of choice prevails, the rate of savings and of investment are functions of the level

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of incomes. While there is no doubt a limit to the extent consumption can be squeezed, there is no solid ground for assuming, at least at low levels of incomes, that the rate of investment, and therefore of advancing prosperity, will not increase more rapidly under conditions of forced savings and directed investment. Divergence from the optimum allocation of resources, in terms of the satisfaction of the wants of consumers and the supplies of the factors of production, may be accepted as a cost of assuring a more rapid rate of growth. We are, I suggest, right in assuming that the prospects of peace are enhanced both by the growth of material well-being, and by the persistence and development of social institutions reflecting values similar to our own. Perhaps we cannot have it both ways. If the second condition is not realized, are we advancing the cause of peace by refusing to contribute to prosperity? I think not

The concept of economic aid as a means of raising the level of prosperity in relatively poor countries and thus of contributing to a peaceful world is a comparatively new factor in the relations between countries. It is therefore not surprising if generally acceptable principles for the provision of aid have not yet been devised. For myself, I am content to accept the concept as both noble and necessary. In this faith we should then be prepared to apply ourselves to the problem of developing effective principles and procedures.

## Impact of Science and Technology

It seems to me that we know really very little about the growth of scientific and technological knowledge, or about their impact on economic growth. The following propositions which appear significant are, I hope, valid for capitalistic countries. First, to define the terms. Science is knowledge of the physical nature of things and understanding of physical processes. Technology is knowledge of how science can be applied to advance human objectives. Techniques are the particular applications of technology manifest in specific situations.

Second, there is a condition which may be described as the propensity for scientific and technological inquiry, which is a component of the culture of the society. Western culture is, with characteristic gradualness, increasingly accepting science as an end, and recognizing its significance as a means to prosperity. In the USSR the belief in science as a means to prosperity is being rapidly inculcated into the general attitudes of the people; and is a basic tenet of the dogma of the leaders. In the countries of the East the propensity for scientific inquiry is low. The propensity is reflected in the content of public education. In Western culture the growth of the propensity can be traced in the changing content of formal education. The high propensity in the USSR is evident in the content of

the curriculum there. Until recently what education was available in the countries of the East contained little science.

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Third, there is a functional relation between income and scientific and technological advance. Research effort requires investment in the training of competent researchers, in the provision of facilities, and in the actual pursuit of research. Given the propensity, the higher the level of incomes the larger the investment in research, both absolutely and relatively.

Fourth, although the gains from research are highly uncertain, they are directly related to investment, and therefore, with the same propensity, the most rapid rate of advance will occur in countries with relatively high per capita incomes.

Fifth, the rate of development of science and technology is related to the manner in which decisions are made. In free enterprise societies, decisions respecting investment in research are made at both the public and private level. The volume of research effort depends therefore both on general or public attitudes, and also on entrepreneurial attitudes. The effectiveness of research is affected by its organization. Some part of the growth of scientific and technological knowledge must come from collective organization and effort; but entrepreneurial research remains an important element. Here, in addition to the attitudes of management generally, and in particular situations, there is a problem of the time element. It is known that industrial research is, in general, heavily weighted in the direction of rapid results. In the long run it is possible that a greater emphasis on more fundamental inquiries directed at the major breakthrough would contribute more to economic growth.

Sixth, the direction of the growth of science and technology is influenced, to a significant degree, by the specific problems currently of concern to the society. In part, these problems are influence by the relative importance of ends. For example, if society is highly concerned with health and welfare, scientific and technological research will be bent in this direction. But even in the area of industrial research designed to expand the output of goods and services, current problems in society affect the direction of research. In public research related to agriculture funds will be available to attack problems about which farmers are currently concerned. Research in industry fastens upon those technological problems evident in the current techniques.

Seventh, the knowledge derived from scientific and technological research is universally valid; but new technology is not applicable in all situations and the particular application which is manifest in the techniques will vary with different circumstances. Science and technology are transferable; but skill is required in applying new technology to particular situations, and there is a limit to the extent to which it can be

applied in circumstances other than those in which it has evolved. Many of the advances in technology currently occurring in a society with particular techniques related to an advanced level of technology are wholly inapplicable in other societies or may be applied in them only with considerable modification.

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The USSR has achieved a substantial rate of growth. This is attributable, first, to the Marxist philosophy which emphasized the dominant role of techniques in determining the character of society; and second, to the institutional forms which made forced saving and investment possible. At the outset the USSR borrowed heavily from the already advanced technology of the western world, and particularly of the United States. At the same time the high propensity for scientific and technological inquiry led to a rapid build-up of their own potential; and today, in so far as a free flow of information is permitted, the movement is no longer one way.

It is not necessary to adopt the whole Marxist philosophy in order to place importance on the rate of scientific and technological advance as a means of economic growth and prosperity. The problem of the nations of the East is that the new nationalism is related to the desire for prosperity. There is a colossal lag in the growth potential. Even with aid on a large scale, the rate of growth is likely to be, from any point of view, distressingly slow. There is little doubt that it can be accelerated by the institutional arrangements which provide for forced savings and directed investment. To deny then these countries assistance because they choose such forms is to drive them into the orbit of the countries who subscribe to the whole Marxist philosophy.

There is, of course, no agricultural science. We may claim certain areas of science for agriculture, e.g. soil science, but we do so only in the sense that soil is mainly relevant to agricultural technology. There is an important area of technology which is related to things as inputs and things as outputs associated with the agricultural sector of the economy. Characteristically, a high proportion of investment in agricultural technological research is public investment. It is clear that, if extensive research is to be done in this area it must be with public support. But the reasons normally advanced for public support fall short of an adequate explanation. In countries which produce for export, public support for advancing agricultural technology may be judged necessary in the competitive situation. In countries which do not export and which severely restrict imports, the reason may be the desire to substitute improved techniques for external competition as a means of insuring a cheap supply of food. You see that I am willing to accept the conclusion that the benefits from advancing agricultural technology are, under competitive conditions, widely distributed and do not rest in any large measure on those engaged Many

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in farming. This is not, of course, the basis for an argument against agricultural research. However, the impact of research on the agricultural sector of the economy may be different from the effect on industry in general.

Advances in technology are related in two broad ways to the statisfaction of human objectives. First, they may result in reducing the real cost of producing the same thing. Second, they may result in the creation of new things. There is a significant range in the degree to which these new things are substitutes for things already available. In the long run, the rate of economic growth is probably affected more by the capacity of science to extend the range of things than by improved techniques for producing existing things. Advances in agricultural technology lead to cost reductions or to the creation of things which are close substitutes for present things. Efforts to expand the range of industrial materials produced on farms have consistently failed. Advances in the nonagricultural sector of the economy proceed from the introduction of cost-reducing techniques and from the introduction of new things, some of which create almost entirely new wants. The inferences are that there is a wider and more diversified field for the application of science to industrial technology than to agricultural technology; that scientific and technological research are likely to be more fruitful of growth in relation to industry than to agriculture; and that the effects of the application of research results in the industrial sector, are, in general, different from the effects on agriculture.

The role of agriculture is to create materials which contribute to the satisfaction of a range or category of human wants, the dimensions of which are physically limited. Superimposed upon these wants, and capable of being associated with the physical materials, are a number and variety of other wants which are not confined within any physical limits. The services which provide for these related wants can be continuously expanded; and it may be expected that research (although not primarily scientific as I have defined it) will be continuously productive in this area in both of the broad directions.

The countries of the North American continent have a relatively highly developed propensity for scientific and technological inquiry and the levels of incomes are relatively high. The rate of investment in scientific and technological research, and the related advances in knowledge, are therefore relatively great. The growth potential, although capable of substantial enlargement with the development of a still higher propensity for scientific and technological inquiry, is comparatively great. However, the pattern of expanding knowledge is uneven in its application and effects on the different sectors of the economy. The growth potential in the nonagricultural sector is large, embracing as it does new products and

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services, substitute products and cost-reducing techniques. The aggregate demand for the products of industry (realized and potential) is indefinitely expansible, and the income and price elasticities are high. The aggregate demand for the products of agriculture has a finite limit which we are rapidly approaching; the income elasticity is low (and approaching zero), and the price elasticity is negative (and approaching complete inelasticity). Under these conditions a continuous decline in the human resources engaged in commercial farming (but not necessarily the rural population) seems to be a necessary condition of economic growth. (You will notice that throughout I have eliminated population as a factor affecting growth.)

### Economic Aid

There are many courses of action which might be followed by countries wishing to contribute to the rate of development of underdeveloped countries. I propose to confine the discussion to economic aid related to excess capacity in agriculture. I do so for three reasons. First, it is necessary within the limits of time to narrow the discussion; second, and with reference to the North American continent, established policies suggest the discussion of some of the alternative approaches would be unrealistic; third, both the United States and Canada, although in differing degrees, are committed to the principle of economic aid. There is in both countries a substantial and perhaps growing body of opinion in support of associating excess capacity in agriculture with the objective of economic aid.

Reduced to its simplest form the rationale of the adoption, by any particular country, of the policy of linking economic aid to excess capacity in agriculture runs as follows.

Public expenditures on research related to agriculture will advance agricultural technology. Improved techniques on farms tend to increase production. The manner in which new techniques are applied in agriculture results, in due course, in a substantial increase in aggregate supply. The pressure of aggregate supply on demand causes a decline in farm prices and incomes. In agriculture the adjustments in the use of resources, directed by relatively low farm prices and incomes, are both slow and painful. It is desirable to temper the processes of adjustment. The appropriate means is to take the surpluses off the market, thus supporting farm prices and incomes. The surpluses are then available to be used for economic aid.

Two objectives are involved—the objective of providing economic aid, and of tempering the adjustments directed by low farm prices and incomes. Relating aid to excess capacity in agriculture should base upon some consideration of alternative means for achieving either objective; approval of these does not exclude relating agricultural surpluses to aid as

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part of the total policy. On the side of aid, the alternatives include migration of population (from countries to be aided), reduction of impediments to exchange, the movement of capital (to the countries to be aided), and technical assistance. On the side of farm prices and incomes, the alternatives include programs designed to restrict production, programs to facilitate the transfer of resources from agriculture, and programs affecting the advance of technology. Only two alternatives need detain us: first, technological assistance to underdeveloped countries; and second, programs affecting the advance of technology.

There is no need to restate the arguments for technological assistance. Assurance of the free and assisted flow of information between countries is the minimum assistance which can be offered. However, as I have argued previously, not all new technology is capable of being applied in other countries, and the application generally requires considerable skill. In the long run the major contribution can be made by the training of scientists and technologists in or for the countries to be assisted. In so far as the problem of adjustment in agriculture is brought about by the effects of technological advance operating through production responses and aggregate supply, the problem could be reduced by limiting public expenditures on agricultural research. Such a policy offends the propensity for scientific and technological inquiry. Perhaps more emphasis might be given to increased research effort in the industrial sector as a means of increasing total demand for the factors of production, and thus facilitating, that is, reducing pain, of movement out of agriculture and into industry.

I return to the two objectives involved in the policy of relating excess capacity in agriculture to economic aid. The acceptance of the first objective reinforces the second; and vice versa. Indeed, the cost of the one is the cost of the other. The real cost of tempering the adjustments in the use of resources is the loss of real income which would have been added if agricultural resources were transferred, or were transferred more rapidly, to other uses. If the nation is prepared to accept this cost, there is no residual real cost in disposing of the surplus as aid. If the nation is not prepared to accept wholly the cost of tempering adjustments, it may assume the residual cost as a contribution to economic aid.

Now, the willingness of the nation to carry the cost of retaining redundant resources in agriculture or of providing economic aid will depend on a number of factors. First, the strength of the acceptance of the objective of termpering the process of adjustment in the use of resources, on the one hand, or of the objective of economic aid, on the other. But the social attitudes involved are undoubtedly considerably influenced by the prosperity already achieved by the nation. The willingness to consider human resources as something more than mere factors

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of production to be moved around at the dictate of the impersonal market, is dependent on the ability to bear the cost, and is therefore a function of real incomes already attained. The willingness to contribute to advancing the real incomes of others is similarly related to the level of prosperity enjoyed by those providing aid. The affluent society may be in a position to accept the cost of retaining redundant resources in agriculture and of contributing substantially to economic aid. The society which is not yet affluent, but hopes to become so, may be less willing to assume the costs either of supporting farm prices and incomes or of contributing to economic aid.

Second, the willingness of a nation to embark on a program of economic aid determined by excess capacity in agriculture will depend on the sources of its income. If the nation obtains a substantial part of its income through exchange, and its agriculture is a significant determinant of income, it is much less likely to see the problem of low farm prices and farm incomes in terms of agricultural surpluses or of excess capacity in relation to the domestic market. The cost of tempering adjustments in agriculture, through disposal of surpluses, will be relatively heavy. It is clear that not all nations can be expected to accept the concept of relating economic aid to excess agricultural capacity with equal enthusiasm.

A program of aid must be governed by agreement freely entered into by the parties of the first and second part. (I shall return to the point that there are parties of the third part.) As between the two parties any acceptable agreement, freely entered into, may be judged to be a satisfactory one, although not necessarily the most satisfactory arrangement from the point of view of either party. The aiding country, which has to bear the immediate cost, may determine the amount of aid. If the program is related to excess capacity, it also determines the nature of the aid. However, as we have seen, the cost of transferring the surplus product of excess capacity may be relatively small, to the extent that the cost of retaining redundant and immobile resources has already been implicitly assumed. The amount and nature of the aid having been determined by the aiding country, the choice of the receiving country is thereby limited; and it is unlikely that the products to be transferred are those which would be given top priority by the receiving country in terms of the effects on its own development program. The receiving country might prefer industrial goods to agricultural products. But, within the limits defined, an acceptable agreement can be worked out.

The terms with which the receiving country would then be concerned are the quid pro quo, if any and the certainty and duration of the agreement. If the nature of the aid offered is determined by the aiding country, the nature of the quid pro quo, if any, might properly be determined by

the receiving country. There is an inherent difficulty associated with the certainty and duration of an agreement tied to the surplus products of excess capacity in the aiding country. We may assume a permanent tendency toward excess capacity in agriculture, but its nature and extent will vary from time to time in an unpredictable manner. There is therefore an element of risk involved. This risk should not be borne wholly by the receiving country. What I am saying here is that the concept of a program of aid is inconsistent with a program which is designed to unload the short-term problems of one country onto other countries. Agreements for aid should be on the basis of continuity over a period of some duration.

I return now to the point that other parties may have an interest in, that is, be affected by a bilateral agreement for aid. The effects on the party of the third part will differ in magnitude depending on the products involved and the normal relations disturbed; but the concern over bilateral agreements is a general one. The difficulties involved must not be judged to be insuperable. They only appear insuperable if we are looking for, and expect to find, solutions. They can be met if we think in terms of an advancing net achievement of goals. There are some general guides. One of them is to be found in Kant's formulation of the categorical imperative: "Act only on a maxim through which you can at the same time will it should become a universal law." You may prefer the statement of the principle recorded more than 1700 years earlier: "As you would that they should do to you, do ye also to them likewise." Although progress in adopting it has been distressingly slow, this is without doubt a sound principle on which to base behavior, and to build international relations.

The principle does not, however, supply the detail for appropriate action in particular situations. In the kind of international relations which are involved in aid programs details sufficient for effective action can be found through discussion, negotiation and agreement on a multilateral basis. This is the second sound principle.

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We cannot be sure that rising prosperity in the underdeveloped counties will result in peace. There appears to be a chance that it will contribute to this end. In view of the importance of peace the chance is worth taking, even at some cost to ourselves. This position is strengthened by any conviction we may have that the elimination of poverty is itself a good thing.

Growth and advancing prosperity spring from the application of existing knowledge to productive processes, and by the expansion of knowledge At both levels investment is involved. The rate of investment, and therefore of advance in prosperity, *may* be accelerated in an institutional

framework which can achieve forced savings and investment. The choice on a national basis may, not unreasonably, be made in favor of these institutional forms.

The conditions of demand for the products of agriculture limit the possibilities of growth in this sector. Industrial research (and perhaps fundamental research) is more likely to contribute to total growth and prosperity, and will facilitate the adjustments occasioned by the application of scientific and technological knowledge to agriculture. The conditions of supply in agriculture, given technological advance and the conditions of demand, make for a continuing tendency to excess capacity.

It is not unreasonable for any country with advanced technology to wish to associate this condition with programs of economic aid. However, the choice cannot be made, nor can effective means of implementation be worked out, without reference to other countries—countries receiving aid and countries affected by the program, either as themselves rendering aid, or in other ways. The logic of the objectives leads inescapably to an expanding system of multilateral agreements arrived at by discussion or negotiation, and modified over time by the same processes.

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The objectives of aid programs, and of cushioning the impact of technological changes in agriculture are enlightened ones. Both objectives introduce relatively new elements into international relations. Providing we proceed from the guiding principle of the Golden Rule, and develop a set of applied rules arrived at by mutual consent or by the evolution of international law, we can, I believe, make real progress in the advancement of the objectives.

## UNDERLYING CAUSES OF CHANGE FROM NATURAL SCIENCES

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Chairman: F. F. Hill, The Ford Foundation

#### SCIENCE, AGRICULTURE, AND THE FUTURE

W. A. NIERENBERG University of California, Berkeley

THE SPECIFIC aim of this talk is speculation on current advanced ideas, discoveries, and techniques in the physical and mathematical sciences that could influence agriculture and agricultural economics in the future. Any speech of this kind must have rigid restrictions imposed. On one hand, it would not be especially appropriate to discuss the many present applications of science to agronomy, largely because most of the audience knows much more of that subject than the speaker. On the other hand, there is no real point in introducing subjects where the imagination has to be badly strained to see a possible future connection with the science of food production. Within these limits, there is still a considerable field for discussion of interesting developments in the physical sciences, their applications and revolutions in procedure which may result.

There are perhaps three broad areas in the physical sciences where we may look for inspiration. These are nuclear physics and chemistry, solid state physics, and high energy nuclear physics. (Perhaps strange-particle physics is a better name for the last.) There are, in addition, two important new techniques that have been developing at a very great rate (for different reasons, one is tempted to remark). The one is data processing and computing by means of high-speed electronic digital computers, and the other is the construction and use of earth satellites. Some of the effects of these advances have already been revolutionary in scope, and the potential in the next few years with them combined is, I am firmly convinced, impossible to fully comprehend.

In approaching the subject, the difficulty of a systematic treatment is immediately evident. The sciences themselves are tightly related and so are the possible applications to agriculture. As an example, we will see that some advances in solid state physics may have a very direct bearing on agricultural processes at the same time that they have an indirect bearing via improvements in computers. However, we will proceed and

attempt to maintain a certain semblance of order.

#### Weather Prediction

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We will begin by considering perhaps two of the most central problems of agriculture, namely weather prediction and weather control. These aspirations are at least as old as the Bible and have been favorite subjects of dreamers and fiction writers for such a long time that it comes rather as a shock to realize that man is probably on the verge of achieving some practical results. One of the simplest and fondest hopes of agriculturists has been the possibility of systematic long-range weather forecasting, A great deal of progress has been made since the first mathematical model was used in meteorology 40 years ago for the discussion of the cyclone. There are essentially three different steps involved in such predictions. The first is framing an adequate mathematical and physical model with all the terms completely understood. This is surprisingly not difficult in principle, because most of the fundamental laws that are involved are well known, such as the hydrodynamic equations of motion and the nature and behavior of the discontinuities or the fronts; most of the questions of stability of these fronts have been answered.

In addition, the fundamental thermodynamic processes are quite well understood, and the behavior of the matter involved is sufficiently well known. Now, the exact hydrodynamic equations are themselves nonlinear, and when all the effects are put into one theory, the result has been hopelessly complicated. Naturally, the most bothersome terms and, it is hoped, the least important ones were initially omitted with results that are difficult to estimate, particularly so when it is realized that the observations used in the calculations are not yet sufficiently good. Adequate tests of different models in the past depended on the availability of good synoptic data, the second step, and adequate computing facilities, the third. The earth satellite will probably be one of the devices for gathering and disseminating synoptic information on the weather. Its greatest contribution will be in the large amount of information that it can accumulate in a short time and the rapidity with which it will be able to deliver this information to a central station. Furthermore, it will augment the presently weakest part of the input information, namely that associated with the region at the edge of the atmosphere. Weather predictions today are being tried on computers that operate at a speed of 24 microseconds per addition and have a storage capacity of 10 million words. In the opinion of the experts, the results of present machine techniques and models are almost, but not quite, as good as those of the conventional professional forecasters. Computers will soon be available that are about 20 times as fast and, because of advances in electronics and in solid state physics, (particularly the transistor and magnetic core storage devices) machines are being contemplated that will perform additions in millimicroseconds. This is a real limit, because this is just about at the velocity of light for intercommunication between the various parts of a computer. This factor of 1000 in speed should be very important in weather prediction. The most complicated models will be evaluated at this rate of a billion additions a second. Weaknesses in mathematics and programming will be overcome by brute force if necessary. The outlook for successful weather prediction is therefore very encouraging. The initial phase will be the rapid testing of many different models with super-high-speed computers based on data collected world-wide and transmitted by earth satellites. At least a few of these models should be successful. The development of any degree of proficiency in long-range weather forecasting will undoubtedly carry with it the ability to make local predictions of short-range benefit over the entire world.

## Weather Control and Oceanography

The problem of actual control of the weather and the related precipitation has been a subject of great speculation among scientists for many years. It is important to farmers, and it is important to governments and groups of governments for its possible applications to the art of warfare as it is modernly conceived in all its aspects. It is not just a simple cliché to say that the nation that develops a significant lead in controlling the weather globally shall have a frightening advantage over the rest of the world. The possibility is upon us, and the warfare potiential is insidious. To illustrate the simplicity, if not the practicality of one scheme, let us consider the very old idea of the deposition of carbon black over very large areas of the world. A fundamental datum in weather control is the solar constant or the energy received by unit area of the earth from the sun in unit time. Carbon black has a greater emissive power and greater absorptive power than the average land surface. The effect of a change of solar energy locally received can cause violent atmospheric disturbance if it occurs over a wide enough area. If the area is ice-bound, largescale melting can occur, and serious changes in the ocean level can result. Conversely the deposition of white powders on dark areas of the earth's surface will cause diminution in the solar energy received and give the opposite effects. The combination of the two schemes gives a considerable degree of flexibility in manipulation. A few years ago, the suggestion was made that this method be employed to solve the Los Angeles smog problem. If several areas in the Los Angeles basin, of the size of quarter sections, were blacked out, huge columns of hot air would rise to an altitude of about 5000 feet or more. These columns would puncture the smog inversion and "bleed" the smog from the valley.

In a broader sense, climate control will have to be understood from

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principles derived from many sciences. There is, for instance, the variation in the power absorbed by the atmosphere caused by the changing carbon dioxide content in the atmosphere. There are many processes involving the interaction of solar energy with the atmosphere that are not yet completely understood. Satellites are expected to offer great help in the solution of these problems. Cosmic rays provide us with a tool for obtaining information about the matter in the space between us and the sun, and so on. These are very interesting subjects, but for illustration in detail I have chosen to go in a different direction and discuss oceanography.

Physical oceanography has been emerging as a science very strongly in the last 10 to 20 years and it is one of the last of the geophysical frontiers. A famous example of oceanographic effects is, of course, the effect of the Gulf Stream on the weather and fishing in western Europe. However, more world-wide knowledge of the circulation of the oceans of the earth is developing at this time. The oceans have a very profund effect on the weather because of the ice, the currents, and the evaporation of water. The properties of the mantle of the earth immediately below the oceanic areas are very different from those beneath the continents. The analysis of earthquake waves has shown the suboceanic rock to be of a different density as well as other properties, and recent seismological work has shown the depth of the Mohorivičić layer to be considerably less than that under the continents. In other words, the mantle is thinner under the oceans. As a result it is believed that the radial heat flow is very different, and recent very difficult and skillfully executed measurements tend to bear out this surmise. This heat flow has a very important bearing on the motion of the oceans and their heat content, just as the solar heat flow has on the atmosphere. The importance of the oceans in climatology is considered by some authorities to be so great that explanations for the cyclic appearance of ice ages have been based on the freezing and unfreezing of northern seas and consequent reactions with changing currents. There have been suggestions made that ocean currents can have their routes changed by damming up shallow reaches or by opening up large sections of icepack.

These suggestions would not have been taken very seriously 15 years ago, but must now be treated with greater weight because of the possibility of employing atomic and hydrogen explosives to move large quantities of matter economically. The first attempts will be made shortly on a smaller scale in an effort to open icebound areas off Alaska to shipping. This possibility of weather control will be an important test of man's ability to survive his own creations. On one hand, the control of ocean currents and ice formation open up great possibilities for increased food production, and, on the other, it is possibly a more devilish instrument of

intercontinental warfare than the direct use of the hydrogen bomb and the ballistic missile.

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The science of oceanography is a very fascinating subject, particularly for a nonoceanographer. The oceanographers deal with huge masses, and immensity itself never intimidates them. A typical example is a solution, offered by an ocean scientist, to one of our most rapidly developing problems-that of an adequate water supply for our expanding population, for industry, and for agriculture. This problem is, of course, under active consideration and some of the methods are in the pilot plant stage of development. The ideas are mostly well-known, but perhaps the most interesting suggestion is based on the giant icebergs of the southern hemisphere that originate from the Antarctic icecap. These icebergs are of the order of 100 miles long and 20 miles wide. The suggestion is that one be towed north (several year's work and many tugs) and located somewhere off Long Beach to supply water to Southern California. Such an iceberg would be a magnificent supply of pure water. I gather that this suggestion is not being seriously considered at the present time, but it is amusing to think what such an iceberg would do to Los Angeles weather.

As the oceanographic studies continue, more and more is being learned about the mineral and animal content of the seas. One of the items that immediately impresses the amateur is that fish husbandry is extremely backward compared to, say, cattle farming. With perhaps whaling an exception, fishing techniques have not seriously changed in thousands of years. There are many examples of entire local industries wiped out because of the disappearance of some particular fish from the region. Often the reason is obvious because of some change in a current; sometimes it is not. Almost never is anything done about it, although suggestions are always made. One of the ideas involves the systematic destruction of weed fish, which is the reverse of the present technique. Possibilities exist of breeding different kinds of fish and, of course, controlling the local currents and water temperatures. There is a real need for constructive research in this field in order to meet the challenge of the decreasing ratio of food supply to population that confronts us. What improved oceanographic knowledge could mean in terms of chlorella algae farming is anyone's guess. In any event, we can avoid discussing it by defining it outside of the present domain of interest.

#### Satellites

We have already treated satellites as a probable valuable tool for obtaining and collecting the necessary input data for global weather predictions. In addition, satellites will have a very important use and application in the general field of communications. The best current opinion is

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that a relatively small number of satellites in orbit at the same time can provide enormous bandwidth for communications everywhere on earth, At the present time, the cost of transoceanic communication is very high, and it could conceivably be reduced considerably by the use of satellite repeaters. Weather conditions, actual and predicted, could be collected and disseminated at a very low cost. The combination of computing machines and cheap communications would allow much more complicated schemes of production, regulation, accounting, and transportation with somewhat better results than we have achieved to date. This is an unimaginative forward step, compared to the speculations that develop over the implications of interplanetary travel. The agricultural problem that faces us within four or five generations is complicated by and related to the great population pressures that are imminent. One can wonder whether these stresses will be relieved by exploration and colonization of the near planets. If this does happen, will a kind of agriculture and natural food production be essayed on these planets, and what are the problems of feeding populations under these conditions? This subject makes interesting speculation for the agricultural scientist. Perhaps the future spaceman would rather live in large space cities that orbit the sun. He would be free of the turbulent unpredictability of the earth's atmosphere and the earth's seasonal variations. He shall have broken the cipher of chlorophyll conversion to food, and the uniform solar radiation will be sufficient for steady-state existence on the artificial planetoid. This is hydroponics on a grand scale.

## Nuclear Physics and Nuclear Chemistry

Nuclear power has just been briefly discussed with relation to weather control. Speaking generally, our demand for power is growing at a very striking rate, and there are those who predict that by the year 2000 we shall have stripped our chemical sources and our nuclear sources and therefore will have to turn to hydrogen fusion for our ultimate source. This is an extreme possibility, but a likely one, and of course it is offered by proponents of the feasibility of hydrogen fusion. This demand for increased power can be considered as a developed political and social pressure, similar to that caused by food supply and water supply problems. However, the availability of nuclear power and fusion power should have no more special effect on agriculture than any other similar endeavor of Homo sapiens. As conventional power is gradually replaced or augmented by nuclear power there will be no marked changes. There is one special feature, however, that may be useful. Nuclear power units in any size can be delivered in packages to isolated areas where continuous chemical fuel delivery would be a serious problem. There are otherwise me can

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nuous rwise arable areas in this world that suffer lack of water only because of vertical separation between source and user, and there is no power available to pump this water up to the heights needed, nor is it practical because of the heights involved to dam the streams for the purpose. The barrancas in Mexico are an example of just such a situation. It may be that the economics is such that water pumping by energy derived from nuclear power sources in these areas will be important to individual countries that now cannot feed themselves. This is obviously not a generally useful application, but it may have very special interest.

To date, the most important relevant application of nuclear physics and chemistry has been the use of tracer techniques in experimental biology. Tracer techniques are important in very many fields, and in the life sciences they have provided us with a wonderful key to the mysteries of metabolism and reproduction. The production of radioisotopes and instruments for this purpose has become one of the large industries in this country, and it will increase notably in the future. It is remarkable to consider the great advances that have been made and will continue in the study of the metabolism of trace elements by organisms. What is less clear, however, is the role played by direct radiation of growing plants and animals. This is a very important subject, both economically and politically, and it is imperative that some of the necessary answers be obtained as soon as possible. A considerable amount of experimentation has been started on the use of radiation to induce favorable mutations for breeding better strains and this subject will be pursued with great vigor. This is a favorable side of the problem. Still the increased use of nuclear processes bring with them a whole host of problems that affect the agricultural scientist. There will be a great emphasis on understanding and controlling the industrial contamination problem. At the present time, wastes are being buried in concrete underground or sealed in tanks and dropped into the deep ocean. There is always the possibility, in view of the long-time scale involved, of escape of the contaminants. It is very difficult to estimate the reliability of engineering over hundred-year periods. The pressure for the solution of this problem of handling radioactive wastes will mount steadily in view of the biological and ecological complexities. About the only safe solution would seem to be the ejection of the concentrated wastes from the earth into the sun by rockets. Even this method would require absolutely foolproof rocketry. Marine and aircraft nuclear propulsion will only aggravate these problems because of the possibility of local accidents. It is safe to say that we will be in for an extended period of stress and strain in social adaptation to these technological problems.

One of the interesting by-products of modern physics has been the possibility of large-scale food sterilization by penetrating gamma rays.

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This should not be classed necessarily as nuclear physics in the sense that intense sources of gamma rays are most practically produced by electron accelerators such as linear accelerators or synchrotrons, as well as from radioisotopes manufactured in reactors. The art of making such instruments of nuclear physics has been for some time at the point where they are available with all the flexibility and ease of operation that a commercial apparatus should have. The initial purpose was for x-ray therapy, but at least one company now has a design for a linear accelerator whose principal use is the continuous sterilization of cased food. This principle has been well known on a laboratory scale for several years, but the practical application had to wait on the commercial development of klystron tubes for radar, since these tubes are the source of radiofrequency power for the linear accelerator.

#### Solid State Physics

One of the greatest expansions of a subfield of a discipline has been that in solid state physics, in the period from the end of World War II to the present time. Risking the danger of oversimplification, it can be said that this development has been spurred by two great scientific events. The first is the invention of the transistor, which revolutionized concepts of the practical benefits that can derive from a good theoretical understanding of the structure of solids, semiconductors in particular. The second development is the general application of radiofrequency techniques to the studies of solids and the behavior of electrons and the atomic nuclei in solids. These phenomena go by the names of paramagnetic resonance and nuclear induction, respectively. A typical atomic nucleus has an angular momentum due to its rotation about its axis of symmetry. This rotation causes it to behave in a fashion similar to a gyroscope when a torque is put upon it. When a sample of material containing this element is placed in a strong magnetic field of the kind you would normally find in a powerful electromagnet, the nucleus will precess with a characteristic frequency in the neighborhood of one megacycle per second because the nucleus is a small magnet, much in the same manner as a simple gyroscope in the earth's gravitational field, and one result of the precession is an electromagnetic signal. This precession can be detected by a very simple type of radio circuit, and the particular atoms that are responsible can be identified by this characteristic frequency. This is a very important supplement to the radioactive tracer technique, because one of the most important atoms, namely oxygen, has no suitable unstable isotope. Furthermore, small shifts in this frequency can supply clues as to the nature of the chemical environment. This tool is being widely exploited in the study of life processes. An electron has a much larger precessional effect than the nucleus se that

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in the same magnetic field, and if there is an unpaired electron present in some organic compound, this precessional frequency is easily detected. This is very important in the study of free radicals, for example. In the case of the crystalline solid, such as the semiconductor, the behavior of the electrons is all-important and determines most of the principle characteristics of the material. The model of a semiconductor now believed to be correct is very complex and very difficult to describe to the layman. Yet, very interestingly, recently the structural ideas of the semiconductor plus the unpaired electron have been applied to the study of chlorophyll. It is a possible thesis that the energy conversion mechanism of chlorophyll is similar to the photosensitive properties of some semiconductors, and as a natural consequence, the technique of paramagnetic resonance is being employed to study this process in leafy material. The initially looked-for effects have been found, and the definitive experiments for this hypothesis are still under way. We are perhaps in the last stages of unravelling the complicated process of photosynthesis. I realize that I have been unnecessarily brief here. The implications of the deciphering of the complex photosynthesis problem are many. It could mean the possibility of direct food manufacture from the sun without the cumbersome use of the plant as a factory.

## Parity and Strange Particle Physics

It would be most unfortunate if we could find no basis this morning for discussing perhaps the most remarkable discovery of this century in physics. There is no even distant application of the discovery that I am aware of, but it would be unfortunate if that were to be considered an impediment to the exposition of a subject which has so much intellectual content. Furthermore, this property did seem to offer a fundamental difference between animate and inaminate processes. I am referring, of course, to the newly discovered violations of the conservation of parity rule. Until two years ago, it was believed by most physicists that the physical laws must be such that they were invariant to an interchange of left and right. These so-called "simple" laws are usually not easily explained, because they have a very strong intuitive basis. Another way of stating this law is to say that the results of an experiment should not depend on whether you use a left-handed coordinate system or a righthanded system to analyze the problem. Or again, it should not matter whether a left-handed man or a right-handed man does the experiment. This concept played a most powerful role in the development of physical thought. This seemed so intuitively obvious to most people that they were unprepared for an explanation of a difficult observation with respect to the @ particle, one of the "strange" particles of high energy physics. It was then proposed that a possible explanation could be a violation of this concept of parity (a more perfect example of a conflict of terminology could hardly be chosen for the present audience). Definitive experiments were proposed on β-radioactivity and they confirmed the suspicions. We are now left with a universe that has a built-in handedness, although the question is complicated by the possibility that we may be only talking about our part of the universe, but that other parts may be occupied by anti-matter and the handedness may be reversed. Now this whole question should be of special philosophical interest to the biological scientist, because this particular intuition with respect to parity has probably never applied to him. The classical example of dextrose and levulose in sugars is an example of left-handed and right-handed biological entities. There are many others, such as the spiral conchs that are always one way and so on. However, the really interesting question is whether any chemical compounds in nature that are definitely inorganic have any left-handed or right-handed tendencies on the average.

#### Conclusions

The conclusion is inescapable. There are more things in store for man than the most agile imagination can decently comprehend. The food scientist will have to adapt himself to a wide variety of technologies, and fluxes and stresses in the practical approach to his troubles will make parity, congressional or physical, seem very simple indeed.

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T. C. BYERLY
Agricultural Research Service, USDA

ALL THE BIOLOGICAL sciences are used in agricultural research. Genetics, physiology, entomology, parasitology, plant pathology, nematology, serology, animal husbandry, endocrinology, veterinary science—classify biologists and biology to your own taste—there are agricultural problems and research achievements significant to agriculture in that field.

About one in two of our scientific staff in the federal-state network of agricultural research is in the biological sciences. The others are chemists, soil scientists, engineers, and farm economists.

The primary objectives of biological research in agriculture are four:

1. To increase quantity of output per unit of input; i.e., to increase physical efficiency.

To protect crops, livestock, and agricultural products against insect, weed and other pests, parasites, diseases, temperature, moisture or its lack, light or its lack, and against deterioration.

To adjust the kind and quality of crops, livestock, and agricultural products to meet specific end uses, both food and industrial, and to market specifications.

To obtain basic biological research information needed to solve problems as they arise.

Since it is impossible to summarize all the significant changes in agriculture in which the biological sciences have a significant research role, we have elected to present a selected sample of the whole in the hope that it may be representative of the whole.

Efficiency of production in terms of yield per acre of all crops, and per breeding unit of all livestock (except horses and mules), has increased more than a third since 1930. These aggregate trends conceal the wide variability in change in efficiency of production among the many kinds of crops and livestock.

Average production and yield for 20 kinds of crops, livestock, and livestock products for the periods 1925-29 and 1951-55 are shown in Table 1. These data will serve as reference material for our discussion.

## More Efficient Feeds for Livestock

Much of the increase in production per breeding unit of livestock is due to application of information from research in animal nutrition. This can also be credited with a substantial increase in output of poultry, meat and pork per unit of feed used in producing these products.

The achievements of animal nutrition research have revolutionized the feeding of pigs and poultry and brought about major improvements

in cattle and sheep feeding. The basic discoveries include the qualitative and quantitative requirements for a dozen or more vitamins, beginning with the discovery of Vitamin A by McCollum about 1912 and continuing to the recent demonstration of a fat-soluble growth-promoting substance in egg yolk. Studies of mineral nutrition have demonstrated quantitation requirements for calcium, phosphorus, iodine, iron, manganese, zine magnesium, cobalt, copper, molybdenum, and within the past two years selenium. Of equal importance are the research findings on high energy diets and on protein and, for ruminants, the use of urea and other protein substitutes.

TABLE 1. TOTAL ANNUAL PRODUCTION AND YIELD PER PRODUCTION UNIT OF CERTAIN FARM PRODUCTS

Product	Total production		Yield per production unit		Change from	
	1925-29	1951-55	1925-29	1951–55	1925-29 base	
		s of tons	Thousands of pounds		Per cent	
Alfalfa	23.3	52.0	4.2	4.3	+123	1 +2
Beans, dry	0.55	0.81	0.65	1.15	+47	+77
Beef and veal	3.63	6.39	0.23	0.27	+76	+18
Cabbage	0.94	1.30	16.1	16.85	+38	+5
Chickens	0.88	1.77	0.0044	0.0096		+118
Corn	73.3	88.0	1.50	2.20	+20	+47
Cotton	3.82	3.75	0.172	0.326	2	+90
Eggs	2.30	3.64	0.015	0.023	+58	+53
Milk	47.4	59.4	4.42	5.56	+25	+26
Oranges	1.46	5.4	9.0	19.0	+270	+111
Pasture and range*	120.0	140.0	0.230	0.283	+17	+25
Pork	4.23	5.4	0.65	0.81	+30	+25
Potatoes	11.7	10.0	7.56	15.26	-7	+102
Sorghum	1.25	4.23	0.71	0.95	+238	+34
Soybeans	0.2	9.3	0.744	1.20	+4500	+60
Strawberries	0.21	0.21	2.20	3.57	±0	+62
Sugar beets	7.4	11.6	21.8	31.7	+57	+45
Sweet potatoes	1.7	0.89	5.15	5.40	-48	+5
Tomatoes	1.8	5.3	8.34	18.4	+194	+121
Wheat	24.6	32.9	0.85	1.08	+34	+27

\* Hay equivalent.

Corn 1866-70—1417 pounds per acre.
Wheat 1866-70— 748 pounds per acre.
Cotton 1866-70—156 pounds per acre.
Production—for crops, acres; for livestock and poultry, per breeding unit.

It is convenient to group discoveries in animal nutrition around soybeans because soybean meal is the dominant protein source in formula feeds, now widely used throughout the livestock industry.

Until 1941, the soybean in the United States was grown largely for forage. The demand for vegetable oil, stimulated by World War II, led to an increased acreage of soybeans harvested as beans. New varieties adapted to the different latitudes were beginning to be released by crop

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 $_{\mbox{\scriptsize breeders}}.$  These have made it possible to increase soybean production  $_{\mbox{\scriptsize tenfold}}$  in the past 20 years.

Soybean meal is rich in protein. The protein content is about one-and-a-half times as great as that in dried milk—until World War II one of the important sources of protein in formula feeds. But the soybean meal lacks other nutritional components found in milk and other sources of protein.

Research made it possible to compensate for these deficiencies. First, it was discovered at the University of Wisconsin that heat greatly improved the efficiency with which soybean protein is used by poultry. Research at Cornell and Ohio established the need of riboflavin to support hatchability in poultry diets relying on soybean meal as principal protein source. Research at Wisconsin and Kentucky demonstrated the need for manganese to prevent parrot-beaked embryos and displaced leg tendons in growing chicks. Research at the University of Maryland and at Beltsville demonstrated the necessity of Vitamin B<sub>12</sub> for hatchability and chick survival. Research at Dupont and federal and state experiment stations has demonstrated supplementary feed value of methionine.

During the 1940's, the Connecticut agricultural experiment station demonstrated the value of high energy diets for broiler production, using diet high in maize content. Energy content has more recently been increased further by addition of stabilized animal fat.

Studies of the fermentation residues from antibiotic production as a cheap source of Vitamin  $B_{12}$  led to another discovery—the spectacular growth response of the young animal of all livestock and poultry species to antibiotics. As the result of this work at Lederle Laboratories and at the Florida and other federal and state experiment stations, antibiotics are now included in feed for all classes of young livestock. They act as growth promotants probably because they inhibit the development of subclinical disease, especially in the young reared in an environment high in bacterial population.

While the achievements of nutrition research have been both solid and spectacular, much remains to be done. High roughage diets, hay, crop residue, mature grasses and milling residues will always be major feed sources, especially for ruminants. We can use them effectively for maintenance and for growth but not as sole sources of feed for high milk producers and for slaughter cattle and sheep.

Feed intake is limited to relatively fixed quantities of dry matter. Obviously, the cow that eats 40 pounds of hay of 50 per cent digestibility cannot produce as much milk as she can from 40 pounds of concentrate of 80 per cent digestibility. Perhaps we can find through breeding, through research on rumen bacteriology, or even through chemical modification of roughage, ways of either increasing intake or digestibility or both.

## Many Gaps in Knowlege of Animal Physiology

Physiology is the broadest of the biological sciences—genetics, nutrition, pathology, in many phases, are only branches of it. Much of the physiological field is barely explored or unexplored. Some of the explorations have led to unexpected applications; e.g., the research on plant hormones which led to the development of weed killers and the research on female hormones of animals which led to quick fattening in young chickens without increase in rate of gain and, conversely, in cattle, led to increase in rate of gain without increase in rate of fattening. Ninety per cent of our feed-lot steers are fed or pelleted with estrogen with a resultant 15 per cent increase in rate of gain.

Basic physiology, the study of energy metabolism, began in the U.S. Department of Agriculture in the 1890's, but only this past year has the department achieved an adequate laboratory for the direct study of energy use by the dairy cow.

Research on animals lags considerably behind that on plants in two important areas of physiology—the effect of temperature and the influence of day length and darkness or photoperiodism. The climatic limits of plant species and varieties are now tested by well-designed experiments. Problems of photoperiodism and the mechanism by which plants use radiant energy are approaching solution.

A major challenge in livestock research is a dairy cow that gives high yields of milk in spite of the heat. The use of Brahman cattle in the South is rationalized as a consequence of their heat tolerance. They are more heat-tolerant than European cattle, but their usefulness in breeding comes from hybrid vigor rather than heat resistance.

The influence of photoperiodism on animals is only superficially known though our limited knowledge is widely used by poultrymen to control seasonal egg production. Even here, we lack the critical knowledge of interplay of light and dark periods and the nervous and hormonal mechanisms of poultry and other livestock species. When this knowledge is achieved the farmer will be able to control precisely the reproduction of livestock.

Another area of research in physiology that holds a challenge is study of the reproductive processes. As one would expect, our knowledge of reproductive processes in animals lags considerably behind what we know about plants.

In the past 20 years, there has been a steady accumulation of techniques for manipulating plant processes. The chemical colchicine is widely used by plant breeders to double the chromosome number and achieve crosses that were formerly impossible. Photoperiodism is used to bring plants into flower for making crosses almost at will. Oaks have been induced to flower within a year from the acorn.

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In livestock production, research has not yet provided the farmer with lines of animals and techniques for getting full crops of lambs, calves, poults, pigs, and chicks. Present efficiency of reproduction—about 70 per cent—represents an important cost. We have fragmentary knowledge of hormones, the influence of day length and other tools that, when completed, can assure full crops of young animals at any season in controlled or ameliorated environments.

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## Progress in Livestock Disease and Parasite Control

Research in the biological sciences has helped to reduce losses from diseases and parasites of livestock and poultry. Among the gains are

(1) eradication of tick fever in catttle of the United States and the insect which spreads the disease;

(2) a diagnostic test for tuberculosis that has reduced incidence of this disease to a fraction of 1 per cent;

(3) diagnostic tests and a vaccine for brucellosis, a disease of cattle that also affects human beings—incidence of this disease is rapidly being reduced;

(4) diagnostic tests for pullorum, a disease of poultry that in the 1920's caused the death of at least 20 per cent of chicks and decimated large broods (these tests were essential to the development of the broiler industry);

(5) sanitation measures that have reduced the spread of parasitical diseases such as blackhead in turkeys;

(6) parasiticals such as phenothiazine, piperazine, and more recently the antibiotic hydromycin, for the control of certain worm parasites in sheep and swine;

(7) livestock breeders are just beginning to develop and exploit a technique widely used by crop breeders—genetic resistance to parasites and diseases. An important discovery in this work is that certain lines of laying hens carry resistance to the avian leukosis complex, a virally transmitted cancerous disease that kills 10 per cent of our laying hens each year.

Since we know very little about the nature of resistance to pests of both livestock and plants, basic research on all phases of immunology is one of our most urgent needs.

We must do research to guard against exotic diseases and parasites. To this end we have recently built an animal disease laboratory at Plum Island, off the coast of Long Island, New York. We are also conducting cooperative research in several foreign countries against such livestock killers as foot-and-mouth disease, rinderpest, African swine fever, and scrapie, a most puzzling sheep diesase.

## Performance Tests and Hybrid Vigor

During the last 30 years a wealth of evidence has been assembled on the heritability of certain traits in livestock. The findings have given support to the purebred breeder who selects from traits such as rate of gain, adult weight, type of conformation, color, horn, comb and feather traits. These traits are highly heritable.

Our emphasis in recent years has been on traits of moderate or low heritability. These include fecundity, viability, and maximum production of eggs, milk, and fleece.

One of the most effective approaches appears to be in crossbreedings. The embryo of a crossbred pig is more likely to survive to birth, weaning, and market age than the purebred. The hybrid sow is likely to farrow and wean more pigs than her purebred dam. The crossbred cow is more likely to drop a calf and it is likely to attain a heavier weaning weight than a purebred calf from the same dam. Egg, wool, or milk production of hybrid females is likely to exceed the mean of the sisters of the dam and sire of these animals.

Heterosis has been recognized as so important that a majority of our feed-lot lambs, probably 80 per cent of our pigs, all of our commercial broilers, and at least one-fourth of our commercial laying stock is crossbred.

On the other hand, most of our dairy and beef cattle are purebreds or grades. Milk production increases steadily year by year. Genetic improvement must be largely attributed to wide and increasing use of superior progeny-tested sires and their sons in artificial insemination. About 20 per cent of our dairy cows are artificially inseminated.

The diminishing market for animal fats has been an influence in our increasing concern with carcass quality. Fortunately, carcass quality is a highly heritable trait though tools for rapid, accurate estimates are still to be developed. The problem is especially important in swine, and performance testing to obtain lines of meat-type pigs is on the increase.

Performance testing of beef cattle is also increasing. The rancher needs all the genetic efficiency in his herd that can be achieved. The overhead of the dam's feed bill with which the calf is saddled is the equivalent of a year's hay supply—about \$50 just now. In swine, the overhead of the dam's feed bill is divided among several hundred.

Breeding research with alfalfa has produced adapted varieties which have more than doubled the acreage of this forage crop in the United States in the last 30 years. The aggregate data indicate little or no increase in yield. Short survival in many areas, weevils, spittle bugs, aphids, diseases add to the cost of production. Demonstration that Lahontan and more recently Moapa are genetically resistant to aphids is encouraging.

Problems to be solved, in part through breeding research with alfalfa,

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hard race out include variation in estrogen content and in saponin content, and other bloat-provoking components as yet not fully evaluated. Alfalfa is not peculiar among forage crops in presenting problems. Ladino, trefoil and other legumes are equally under question with respect to estrogen content in relation to breeding behavior of livestock consuming them.

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The enormous variation among the grasses has hardly been touched by genetic research. Browse contributes importantly, especially during winter, to the nutrition of much of our livestock, but our principal concern so far is not to breed better browse but how to rid our ranges and pastures of brush. Our biggest research problem is to make our billion acres used as pasture and range more productive on a sustained, economic basis. Part of the answer must come from breeding research.

Research on breeding improvement of wheat, rice, oats, barley and flax is carried out in an effectively coordinated group of laboratories and and test stations, private, federal, state and foreign. Thousands of breeding combinations are tested each year for insect resistance, resistance to rusts and other fungi and to bacterial and viral diseases, for yield and for quality in many locations. So effective is this system that when Hoja Blanca (white leaf), a devastating virus disease of rice, appeared in Florida last fall, more than half of the 3,000 rice strains in the world collections had already been tested for resistance and more than 200 demonstrated to have genetic resistance. Among them were a few short grain varieties of commercial potential. Fortunately, the disease has apparently been eradicated from Florida.

We have hopeful material to meet the threat of a new strain of crown rust to oats. We've had to change our oat varieties about three times in the past 25 years to meet newly emerging diseases and new races or strains of old diseases. And the end is not in sight. Resistance must be combined with yield and quality. Even so, the genetic material is sufficiently simple to be quickly manipulated so that new breeding combinations can be evaluated, stabilized, and propagated in about seven years' time. As an example of what breeding research has done in these cereals, we will consider only wheat.

Adapted varieties were the foundation of wheat production in the West. Fife and Bluestem dominated the hard red spring wheat area till about 1915. Marquis was introduced from Canada in 1912 and was grown on about 90 per cent of the area by 1929. Quality was excellent and it usually got by stem and leaf rust for a time. Ceres came in in 1926. It was resistant to the then prevalent races of stem rust and had some drought hardiness. By 1935, Ceres occupied 35 per cent of acreage when stem rust race 56 struck in epidemic proportions. The new Thatcher variety stood out that year and by 1939 it occupied 40 per cent of the spring wheat

acreage. But Thatcher is very susceptible to leaf rust and suffered badly in 1939 and 1941. Mida, resistant to then prevalent leaf and stem rusts, became the leading variety by 1949. Selkirk, developed at the Winnipeg laboratory of the Canada Department of Agriculture, is generally resistant to prevalent races of leaf and stem rust. Released in 1954, it is now grown in the United States on at least 60 per cent of the wheat acreage in the hard red spring wheat area. This succession of varieties has met successive rust attacks, maintained milling quality, and increased genetic capacity for yield.

Durum came into commercial production about 1910. Kubanka was the dominant variety till about 1945, when new varieties—Mindum, Stewart, Carleton, and Vernum—assumed dominance. Resistance to stem rust 15B was lacking in these new varieties, and Durum production in the United States fell to about 5 million bushels in 1954 from the 30 million average annual production for the previous 10 years. Quick and effective work by cooperating state and federal research workers established 15B-resistant

strains of Durum of fair quality and the crop is normal again.

Hard red winter wheats for the southern Great Plains should be cold hardy, drought resistant, rust, smut and Hessian fly resistant in addition to having high yield and quality. Varieties used before 1900 had few or none of these qualities. Turkey had them; early research identified superior lines of Turkey. It became the dominant variety and remained so till about 1935. Pawnee, Comanche, Triumph, Wichita, and Westar and others have taken over in the past 15 years. These new varieties occupied over 35 million acres in 1949 and are estimated to have increased yield about 90 million bushels above the amount that Turkey would have produced in those same acres.

In the Pacific Northwest, wheat improvement has been chiefly directed against bunt (stinking smut). Short-strawed, lodging-resistant lines and high yielding winter wheat varieties adapted to the area have been achieved, but a sucession of varieties has not wholly solved the bunt problem. Much of the wheat grown is soft white wheat, suited to pastry

flours.

In the eastern United States, most of the wheat is soft red wheat except in New York and Michigan, which grow soft white wheat. Hundreds of varieties had been tested for yield and quality by 1900; since 1900 more than 90 improved varieties developed by state experiment stations alone or in cooperation with the U. S. Department of Agriculture. Thirteen of these were grown on more than 100,000 acres each in 1949.

In total, about 284 new varieties of wheat were released from 1900 to 1953. Eighty-eight were selections from old varieties, 127 originated from

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hybridization of two or more varieties, 55 were introduced from other countries, and 14 were of undetermined origin.

Vegetable crops, in general, have had scant research attention relative to their myriad number and problems and their aggregate value. Research has produced many new and higher yielding varieties, some of them of improved quality. As examples of vegetable crops we have selected potatoes, sweet potatoes, dry beans, cabbage and tomatoes.

We have had an effective, coordinated potato breeding program among the U.S. Department of Agriculture and state agricultural experiment stations for 25 years. Two-thirds of our present commercial varieties have resulted from that program. Much of the doubling in per acre yield shown in Table 1 must be attributed to increased fertilizer use, disease-resistant varieties, and development of effective insecticides. This combination keeps our potatoes growing until we have to use defoliants. We often harvest them immature, scarred, bruised, and ready to rot. Careless harvesting and distribution are not the only causes of poor quality. Good varieties are grown outside their area of adaptation; e.g., Russet Burbanks, which produce the finest baking potatoes in the world in the Snake river plain, are something less than perfect when grown in the cooler Maine area to which other varieties are better adapted.

We haven't kept pace with the problems of sweet potatoes, which have sharply declined in production, barely held their own in yield. Research has demonstrated the biological requirements for curing and storage, and identified the causal agent of internal cork as a virus and demonstrated that they can, by appropriate laboratory methods, recover virusfree stocks from contaminated ones. The biologist cannot, or at least has not, beaten the high labor requirements of producing sweet potatoes. Perhaps the engineers will.

Research has produced new fusarium and mosaic-resistant varieties of cabbage through U.S. Department of Agriculture-Wisconsin cooperation in that state. Yield has not increased materially but yield was high 30 years ago. Bolting remains a problem in the southern areas where cabbage is winter grown. Variation exists but research is still needed, Chewing insects still thrive on cabbage and too many of them seem able to adapt themselves to a diet containing insecticides lethal to most of them on first application.

Tomatoes have increased, almost trebled in production, more than doubled in yield. A lot of the increase is due to increased acreage in specialized areas in California where yield is about twice the average for the rest of the United States. Breeding research has produced varieties of excellent yield and quality and wilt-resistant, such as the widely

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grown Rutgers. Of special interest is the pomodoro variety, Roma, produced by Porte at Beltsville. This fusarium-resistant, high quality, high yielding variety has become the variety of choice among tomatoes of this type. Breeding research has yet to produce varieties resistant to the late blight fungus and to the leaf-hopper-spread virus disease curly top. This disease makes commercial tomato production very hazardous in the intermountain area.

Personally, I am unhappy about the quality of out-of-season fresh tomatoes generally available in our markets. Apparently the trade is reluctant to market the much superior ripe pack, picked pink, and stick to green pack, which are both rubbery and tasteless. Perhaps more research is needed on the biology of tomatoes after harvest. Recent time-temperature control studies to reduce waste and spoilage and improve quality of tomatoes reaching retail markets indicate a potential that may soon be realized.

Sugar beet production increase is principally due to increased yield per acre. Sugar beets were threatened by curly top and yield grossly limited in affected fields until breeders developed genetically resistant strains. More recently they have developed monogerm hybrids which have helped make possible planting to stand. Growers say that when yield is pushed high by water and fertilizer use, sugar content of the beets is low. This problem, if it be a limiting factor in yield, will require basic physiological research for its solution. It is one example of the general need for biological as well as chemical research on quality. The farmer of the future must grow products to meet the specifications of the purchaser; he must do it consistently and predictably.

Orange production has trebled and yield per acre more than doubled. Citrus breeding research has produced seedless and superior quality grapefruits as well as bigger and better oranges. Nematodes, viruses and frost still plague the grower. Now breeders talk of the virtues of nucellar seedlings, developing from adventitial tissue. These are genetically identical with the bud stock that produced them and apparently are virus-free even when produced from seeds from infected trees. The Florida freeze last winter and the serious one in Texas a few years ago have stimulated emphasis on research on cold hardiness.

Strawberries, too, have gone to California where new varieties which produce for a six-month period have helped lengthen the season during which fresh berries are available and helped increase per acre yield. These big, beautiful berries would benefit from some research to improve flavor. Recent isolation of virus-free strawberry stocks and development of laboratory test methods for the identification of such stocks should greatly benefit strawberry growers everywhere.

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The westward movement of cotton to the irrigated Texas high plains, the Rio Grande valley, the Salt River valley in Arizona, and the central valley of California, all irrigated areas, increase in use of fertilizer, insect control, and supplemental irrigation in the delta, account for much of the increase in per acre yield. Breeding research has contributed to both quality and yield recently with dramatic improvement in extra long-staple cotton. Research-produced Pima S has freed the United States from dependence on imported cotton of this type. Breeding research of today, with the probable development of superior hybrids, should be greatly helped by recently discovered means for chemical induction of male sterility so that line crosses can be assured by growing alternate rows of these lines without the necessity for hand plucking the anthers on the female parental line. We still have the problem of using insecticides on schedule that will not harm the bees upon which we must depend for pollination, but we're making progress.

Entomology has contributed and must continue to contribute research results essential to the protection of our crops. Two major oubreaks of grasshoppers have been suppressed this year, the Med fly has again been eradicated from the Florida citrus groves, and the boldest plan for elimination of an insect pest, that against the screw-worm fly, is under way. Biological research on the screw-worm fly demonstrated that the female mates but once and that a sterilizing dose of radiant energy from a Cobalt source is compatible with the subsequent development of vigorous adults. In order to use these results in a control program it was necessary to develop methods of controlled propagation in captivity. Lines of flies which would reproduce on a meat diet instead of living flesh were developed. Methods for airplane dispersal of sterilized flies were developed. A pilot test on Curacao demonstrated that persistent additions of sterile males led to matings of such males with all wild females with subsequent production of sterile egg masses and final extermination of the screwworm fly.

Insect control is much hampered by development of insecticide-resistant insect populations. We are conducting pioneering basic research on insect physiology and pathology which may yield the information about resistance necessary to effective insect control.

Biological control of insects is of equal importance. The boll weevil, the corn borer, many flies, mosquitoes, midges, mites and ticks annoying our livestock and ourselves seem unlikely to be eradicated by physical or chemical means. Predators and parasites and bacterial and viral diseases may be used to overwhelm them. There is a great deal of research to be done before this speculation may become a confident prediction. But biological control has made major successes. The cottony cushion scale

was eradicated from our citrus groves by ladybird beetles collected, imported and distributed for the purpose. The people at Fortuna, California, dedicated a monument last month to the chrysolina beetles which have reduced the Klamath weed to a minor nuisance in an area where it threatened to take over the country. Insect explorers in the Middle East and Mediterranean countries have found some insects fond of Halogeton. Maybe we can control this noxious weed as has been done with the Klamath weed.

Biological research will revolutionize the agriculture of the future. We will find methods of predicting reliably the genetic capacity of crop and livestock matings before conception or pollination, and use only those which will yield progeny suited to the specific end use desired and in the quantity needed. We will understand the physiology and genetics of the host-parasite relation, of immunity to disease, to insect, to parasite, to decay, and manipulate our crops and livestock to meet the environment in which they can be most efficiently and conveniently grown. In biology we know many sequences of events, a few causal relationships. Basic research will disclose why and how life processes operate.

#### DISCUSSION: IMPLICATIONS TO FARM POLICY

## HAROLD G. HALCROW University of Illinois

Considerably different implications for policy can be drawn from the two comprehensive and scholarly papers presented to us by Nierenberg and Byerly. Nierenberg has described some of the revolutionary developments in the physical and mathematical sciences. These could greatly alter the conditions for plant and animal production. Most of these developments are not now in commercial use, however, and many years will probably elapse before this is the case. In contrast, Byerly shows that advances in the biological sciences are less spectacular, more regular, cumulative and evolutionary. These advances are constantly fed into the production stream.

Nierenberg, in emphasizing climatology and oceanography, has drawn our attention to the fact that water is the common requirement for virtually all land resource development. Physical scientists are following two lines of research in an attempt to break through the limits to land development created by a given water supply. One is to try to make more rain or snow fall than will occur naturally. The other is to develop a cheap process for desalting sea water. Although a great breakthrough is always possible, neither of these methods has anywhere approached the level of costs required for commercial agriculture. There is some evidence that seeding clouds with nucleated agents has had a small effect on precipitation but this evidence is still not conclusive. Aside from this,

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distillation of sea water is as yet far too expensive for agricultural use, costing more than 50 times as much as the average for irrigation water. As far as I know there is no way to estimate the cost or effectiveness of using some of the inventions or techniques described in more detail by Nierenberg. The use of carbon black to control weather may have almost limitless possibilities. But I expect that advances in the next few years will be restricted to factors which have less effect on aggregate production such as improved forecasting and more efficient methods of data processing.

As I interpret Byerly's paper, we should expect further advances in biological sciences but we cannot rely on developments having as great a production effect in successive decades as occurred in the past. On the other hand, we do not fear food shortages in the United States and Canada; and our exports should bulk as large in the future relative to domestic demand as has been the case in the past two decades. Unless one or two of the great breakthroughs such as mentioned by Nierenberg occurs, the terms of trade for farm products will not decline over the next decade or two, and the terms of trade for farm products will be in equilibrium at near the current levels.

If the above conclusions are correct, farm programs or farm policy will continue to veer toward a middle ground, away from the extremes both of a more rigidly controlled agriculture as well as an agriculture operating on a completely free market. Farm policy in the United States would center around four types of activities having a bearing on markets—(1) price support for certain storables on a more "flexible" basis than formerly, (2) commodity promotion programs, (3) export subsidy largely to compensate for support programs, and (4) conservation programs aimed at establishment of a limited acreage in a "conservation reserve."

I would have liked to see an additional paper in this program dealing with advances in the social sciences for here there are other important implications for policy. In fact, science—physical, biological and social—imposes challenges to agricultural policy makers which are difficult to overestimate. On the one hand the combined effects of scientific knowledge can result in a rate of progress over the world which a few years ago would have seemed fantastic. On the other hand surpluses in agriculture or other parts of the economy can drive us to more restrictive measures on production and trade. I do not believe such restriction would benefit agriculture over a period even as short as a decade. There is a great need for agricultural policy to be consistent with a program of freer trade, improved educational attainments, general economic and social progress. The conditions for economic progress need to be more widely understood and appropriate policies developed. This, I believe, is the enduring challenge and implication for policy.

#### DISCUSSION: IMPLICATIONS TO FARM MANAGEMENT

H. R. JENSEN University of Minnesota

Participation of physical and biological scientists in agricultural economics association meetings is a new experience. Their presence and their presentations recognize and point up the need for team endeavor among physical, biological and social scientists in their agricultural research efforts. New discoveries in agricultural production stream forth from the physical and biological sciences to challenge the agricultural economist, in general, and the farm management specialist, in particular, to see that the discoveries are meaningful, economically, for decisions in agricultural policy and farming. To meet this challenge the agricultural economist at minimum needs to keep abreast of new discoveries; at maximum he needs to participate in planning research which leads to the kind of discoveries that are most meaningful economically to choice making on resource use in farming and agricultural policy.

The primary objectives of biological research, as outlined by Byerly, are (1) to establish new production coefficients, i.e., increase output per unit of input, (2) to maintain present production coefficients, i.e. prevent output per unit of input from decreasing, (3) to adjust kind and quality of crop and livestock product to market demands and (4) to engage in basic biological research to yield information as a basis for answering future

problems.

Available information shows that the research results outlined by Byerly have contributed significantly to Objectives 1 and 2. We know much less, I suspect, about the contribution of biological research to

Objective 3.

To a large extent, biological innovations are total output increasing and total cost increasing to the agricultural industry. With a price elasticity of demand of less than 1.0 for most agricultural commodities, these innovations are expected to decrease gross revenue, increase total costs and decrease net revenue-unless increases in population and employment levels and in consumer incomes more than offset the effects of the low price elasticity of demand. To individual farmers (the innovators) in the short run, biological discoveries will decrease unit costs, increase gross revenue and hence increase net revenue. In the longer run, as added output affects prices adversely, profits to the majority of farmers may very well drop below the pre-innovation period-unless other forces offset the output effect on price. Under these conditions, the individual farmer needs to attach a premium on acquiring information to keep abreast of biological discoveries and on being among the first to put them into practice.

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Of course, if all farmers were among the first to put these new discoveries into practice all would be innovators and no farmer would have a profit incentive for innovating. All would be in the position of the imitators who are forced to adopt the new discoveries in order to try to maintain their income levels. As the situation is, some farmer are innovators—the ones who reap the income benefit from new technology. Most farmers, though, are imitators who are forced to adopt the new technology as an attempt to maintain their incomes. Some farmers are nonadopters because of a lack of capital or education or because of particular value systems. The imitators and nonadopters (the bulk of the farmers) pay a high price to assure the nation's consumers an adequate food supply at relatively low prices—unless offsetting forces are operating.

To the administrator of biological research this cost to the majority of farmers, along with the accumulating surpluses of many agricultural commodities, suggests, at least for the immediate future, a reallocation of research funds—less for establishing new production coefficients and more for maintaining present production coefficients, reducing yield

variability, and fulfilling Objectives 3 and 4.

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For the longer run, the administrator of biological research will want to continue research that establishes new production coefficients, i.e., increases output per unit of input in order to meet the nation's goal of economic growth. High living levels for the nation's consumers can be attained only with relatively large quantities of resources in secondary and tertiary industries and with relatively few in agriculture and other primary industries. Biological research which makes possible more product from the same resources in agriculture is basic to continuous economic growth. Thus, I'm not suggesting that biological research on new production coefficients be discontinued, but I am suggesting that conditions at present and in the forseeable future suggest a change in emphasis, i.e., a decrease in funds for discovering new production coefficients to an increase in funds for maintaining present coefficients, reducing yield variability, and for attaining Objectives 3 and 4. The implications of continuous economic growth to the farm manager are to adjust resource use to exhaust the existing economies to size, to operate with economically optimum factor-product, factor-factor, product-product and time-time combinations and to minimize the opportunity costs of resource use. To the farm management researcher the implications are to concern himself not only with the micro effects of new technology but the aggregative effects as well. Somehow or another, this flow rate of new production coefficients needs to be geared more nearly to the nation's needs and to the rate at which farmers can adjust to them. The farm management specialist can serve to identify the kind and magnitude of adjustments needed and expected.

Byerly points to the wide variability among crops and livestock in increases in output per unit of input. The implication of this fact to farm managers is their need to keep informed about biological discoveries if they desire to increase profits. Differences in increases in output per unit of input among crops and livestock may shift the comparative advantage among these products to require new product, factor and factor-product combinations for maximum profits.

Biological discoveries in animal nutrition have increased the number of variables to consider in making decisions about livestock rations. Consequently, farm managers need to spend more time learning about and analyzing new information on feeding or else transfer decisions on rations and feeding to feed specialists as has been done in broiler production.

One of the major uncertainties facing farmers stems from the impact of weather, insects, pests and diseases to give rise to variability or technical uncertainty in crop production and in livestock reproduction and production. Through breeding, pesticides, insecticides, antibiotics, etc. biological research has increased the farm manager's power to cope with the vagaries of weather, insects, pests and diseases. In other words, biological research has contributed significantly to reducing the farmer's technical uncertainty. Breeding to reduce or eliminate variability in calf, lamb, pig and other livestock crops helps the farmer plan his work load, buildings, feed and other resource requirements and helps him bring his expectations and plans in line with his realizations. Breeding to increase genetic resistance to crop and livestock diseases, to the influence of weather and the ravages of insects and pests also reduces product variability and costs. Control of diseases, pests and insects through vaccines, parasiticides and insecticides also reduces production variability and technical uncertainty to a known cost for the farm firm. In view of the farmer's costs of adjusting to technical uncertainty and in view of the mounting surpluses of a number of farm commodities, administrators of biological research might well consider, for the forseeable future, the use of more funds for the primary purpose of reducing crop and livestock yield variability and less for discovering new production coefficients. Research which reduces or eliminates yield variability may at the same time in the aggregate be total output increasing. Whether it is total output increasing depends on the yield level at which variability is reduced or

The third objective of adjusting kind and quality of crop and livestock product to market demands appears difficult to fulfill without more knowledge of the kind, quantity and quality of product consumers want at various prices at a given point in time and over time. With more knowledge about consumer preferences the agricultural economist can help

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the biological researcher attach the weights that will yield product characteristics in the proportions (e.g. lean to fat in pork) preferred by consumers. In the meantime, the farmer cannot always be sure of what the consumers want.

Toward the end of his paper, Byerly says that "in biology we know many sequences of events, a few causal relationships." This statement, it seems to me, is a challenge to the farm management specialist—whether a farm manager or researcher. I believe we would be better predictors of outcomes if we also knew many sequences of events.

## DISCUSSION: IMPLICATIONS TO AGRICULTURAL MARKETING

## BEN C. FRENCH Michigan State University

I have been quite impressed with Byerly's examples of achievements in biological science and somewhat intimidated by the potential of the developments in physical sciences described by Nierenberg. To assess the implications to agricultural marketing is no easy task. But first I must point out what seems to me to be an important omission in Byerly's paper, at least from the viewpoint of those interested in marketing.

Nowhere among the excellent discussion of research in animal nutrition, physiology, breeding, entomology and pathology is there any reference to "food technology." The important biological developments in processing and distribution of agricultural products are almost totally ignored. Surely no biologist would want to overlook the achievements which led to the production of oleomargarine, or frozen juice concentrates, or frozen vegetables, to name a few.

It is important to recognize at the outset that although achievements in natural science have been and will be *necessary* for many of the changes occurring in marketing, they may not be *sufficient* in themselves. Changes typically are a result of a complex of developments from many sources.

Most of the achievements in natural science which have had or are likely to have significant impacts on agricultural marketing fall into one of the following four classes.

## Discoveries Leading to Alteration of the Environmental Conditions of Production

Here we include developments such as the new strawberry varieties in California which have so greatly increased the growing season and yields; control of diseases; new power sources which may bring water to previously arid lands; and, of course, control of the weather. These are achieve-

ments which may alter comparative advantages in production or permit

production of commodities in areas hitherto poorly suited.

Control of weather and redistribution of water resources with cheap power could produce a revolution in the location of production and consequently a great upheaval in the structure of markets and marketing facilities. Improved efficiency or productivity in one region may be associated with at least temporary inefficiencies in other areas. A transfer of resources is involved. While we may justly argue that this is progress, it creates as well as solves problems.

## Discoveries Leading to New Production Processes

Our speakers have presented an impressive picture of the relentless advance of technology—an advance that leads both to changing methods of performing marketing functions and changing marketing requirements.

Most achievements produce small changes in production processes and efficiency and tend to be adopted gradually, with some lag. Owners, directors, managers strive to keep up. Some do. Others drop off at various stages of development. Some are left completely behind. Firms at the forefront today may find themselves bypassed technologically tomorrow. As a result, examination of the facilities of many of our agricultural marketing industries reveals not a set of identical or closely similar processes but rather a cross section of the history of technological development.

The wide variation in observed technology is not, in itself, evidence of inefficiency. Many of our technological advances involve increasingly large fixed investment—substitution of equipment for labor—and require larger scale for efficient operation. With no alternative uses, part of the cost with existing technology is sunk. Thus even with higher direct operating cost, "old" methods may, for a time, be more economical to

individual firms than the adoption of newer technology.

Achievements which lead to very radical changes in production processes, however, are often adopted rather quickly. A notable example is the development of vacuum cooling of lettuce. Adoption of this process not only led to a radical change in the shipping container—from the wooden crate to the corrugated paper carton—but moved the packing out of the packing house into the field. In the space of about five years 92 per cent of the lettuce in the Salinas district of California was shifted to field packing and vacuum cooling.

These advances in technology which have enabled the marketing system to perform with increased physical efficiency have also created problems. In the case of the lettuce industry it was what to do with the old packing facilities. Marketing firms are also faced with added uncertainty—fear of obsolescence. The vast array of equipment and methods (processes) available make the selection of optimum technologies for particular con-

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ditions extremely difficult. In many cases it is virtually impossible for management to obtain all of the economic information required for a "best" decision in plant design and construction. Questions also arise as to how gains in marketing efficiency are to be shared among agricultural producers, consumers and marketing agencies.

## Discoveries which Facilitate the Transfer of Ownership

Developments in communications have created national and world-wide markets for commodities and have permitted a more orderly distribution of products. Recent inventions such as the transistor, described by Nierenberg, will most certainly improve and add flexibility to our methods of communication. But I do not anticipate any great impact on agricultural marketing.

Research in biological sciences which leads to more uniform high quality products facilitates the establishment of grades and standards so necessary for efficient sales operations.

## Discoveries Leading to the Development of New Products and Methods of Preservation

Some of the newer developments that bear watching are control of bread staling, use of antibiotics in food preservation, creation of a new flaked potato product, controlled atmosphere storage of apples, irradiation, and super-quick freezing with liquified gas which may permit tomatoes and salad greens to be frozen successfully.

Some achievements of this sort, such as the development of margarine, have led to displacement of established substitutes, with far reaching consequences—resource transfers, restrictive legislation, government expenditure and programs and even upheavals within the agricultural economics profession itself.

Over-all, the creation of new products and methods of preservation has made the marketing job larger. The supermarket today carries some 3000 to 5000 items, as against 1000 to 2000 in the grocery store of the 1930's—many of these items with a considerable amount of built-in service. The variety of products, packages, and methods of handling create added problems of quality and coordination of farm production and marketing, and add to the complexity of management decision.

These conditions create pressures for greater specialization and integration of farm and marketing activity as a means of controlling quality and combating the uncertainities growing out of an increasingly complex and rigid marketing structure. Agricultural products tend to be sold more and more under conditions of imperfect competition with increasing nonprice competition and large scale operations.

Just as the marketing system has changed as a result of the many

achievements in natural science, so also has the job of the marketing economist. The achievements of natural science which have added so abundantly to our way of living have created new and continuing economic problems. The complexities of the system, the rapidity of change, the increasing alteration of the original farm product and the combination of product and service have also made the research task more difficult. Finally, perhaps the most significant of all, the economist cannot work in isolation. He must be aware of the developments in natural science and he must attempt to anticipate their economic consequences.

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Chairman: D. S. Anderson, Commodity Stabilization Service, USDA

SOME RECENT DEVELOPMENTS IN ECONOMIC THEORY AND THEIR SIGNIFICANCE FOR AGRICULTURAL ECONOMICS

O. H. BROWNLEE University of Minnesota

Your CHAIRMAN has asked me to present what I have interpreted to be a brief survey of recent developments in economic theory. Unless one is ignorant or believes that little recently developed theory is useful, to present such a survey in 30 or 40 minutes is a large order. Books have been devoted to covering only a part of the area. Consequently, my remarks may prove somewhat superficial to those of you who are familiar with some of the fields and too brief to be informative for those who are unfamiliar with the areas I will attempt to describe. In trying to avoid this danger, I'll restrict my comments to a few developments. My documentation of the things I shall discuss is very incomplete, and if I fail to identify particular developments with particular individuals or to list all of the important works in the areas I shall discuss, such failure is without malice.

As a beginning date, let me take that at which Keynes' General Theory of Employment, Interest and Money appeared. Although I do not believe this work to be as revolutionary as some people consider it, it stimulated work in macroeconomic theory and measurement that has been responsible for many economists keeping an eye on general economic developments and participating in discussion about economic policy. I consider most of the developments of the past two decades to be a kind of "tidying up" rather than to be bold strides. For example, propositions which intuitively appear reasonable and which had been shown to be true in special cases have been proven for more general cases. Or, someone demonstrates that certain propositions in seemingly unrelated fields are analogous propositions. However, there have been some developments that have changed markedly the thinking about certain kinds of problems. Although these developments may be related very closely to some previously existing notions, the earlier discoverers usually were not aware of the significance of these aspects of their formulations.

By an economic theory I shall mean a body of theorems presenting a systematic view of a particular part of the subject matter generally referred to as economic behavior. The theory must have assumptions and implications, i.e., it cannot be purely descriptive. And for the theorems

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to be meaningful they must be "about empirical data which could conceivably be refuted, if only under ideal conditions." I do not wish to pursue the question of how one distinguishes good theories from bad ones, but I shall try to describe developments in theory that I believe will improve our predictions about what will happen if certain conditions prevail. In this sense, I hope that I have identified good theory. The "what will happen" can be useful not only in predicting behavior but also in offering advice either with respect to public policy or with respect to how an individual economic unit should behave if, for example, it wishes to maximize the expected return to the resources which it owns.

## Mathematical Programming

One of the most important developments that has occurred in economic theory during the past decade is mathematical programming, particularly linear programming. Linear programming is a way of stating and solving certain economic problems, including many of the problems facing business firms. It already has been applied to some problems of farm management and marketing and rapidly is becoming a part of the tool kit of many agricultural economists.

Linear programming is important to economic theory because it permits solutions to problems in an area that might be called "linear economics." This area had been neglected by economists in spite of the fact that technologists have argued that many technological situations are described more accurately by some of the implications of the basic assumptions underlying linear programming than by the traditional concepts. Prior to linear programming, if fixed proportionality was assumed to prevail among products and resources in production, such problems as the pricing of productive agents could not be solved satisfactorily by economists, so such situations usually were not treated in economic theory.

The basic concepts of linear programming are well known and are much more adequately described in other works than can be the case in this paper. I shall state these concepts briefly together with some of their implications in order that some of the basic characteristics of the model underlying linear programming will be apparent and can be contrasted with those of the classical model.

A linear programming problem is one in which a linear "objective function" is to be maximized (or minimized) subject to certain linear

<sup>&</sup>lt;sup>1</sup> Paul A. Samuelson, Foundations of Economic Analysis, Cambridge: Harvard University Press, 1947, p. 4.

<sup>&</sup>lt;sup>2</sup> Refer to Robert Dorfinan, Paul A. Samuelson and Robert M. Solow, *Linear Programming and Economic Analysis*, New York: McGraw-Hill Book Company, 1958, p. 1.

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restrictions. In some economic problems to which linear programming has been applied, an "objective function" is "profit" or the return to certain resources whose quantities are assumed to be fixed and for which no prices have been established. Total "profit" is the sum of the profit per unit level of operation of each process or activity multiplied by the level at which each process is operating. Any profitable process is prevented from operating at an infinite level by restrictions upon the amounts of certain required resources available and by the assumption that any activity must be operated at a nonnegative level. The product and resource bundle characterizing a process can be treated mathematically as a vector, thus implying fixed proportionality among the products and resources in any process, constant returns to scale and no external economies or diseconomies in production.

If the "objective function" is "cost," one minimizes the sum of the cost of each activity operated at unit level multiplied by the level at which each activity is operated, i.e., one chooses the various activity levels in a way such that cost is a minimum. The restrictions may consist of certain requirements that must be fulfilled, e.g., a given number of units of a particular product must be produced.

There are numerous examples of farm management problems stated as linear programming problems. There are two kinds of farm management situations to which linear programming has been most frequently applied. (1) A farm enterprise—such as producing hogs in a particular way—is considered as one activity; another enterprise—perhaps producing milk in a given way or producing hogs in way different from the first one—is considered as another activity, etc. The amounts of some resources—labor, land and/or capital—are considered to have upper limits. The combination of enterprises that maximizes profits is chosen.<sup>3</sup> (2) Certain dietary requirements for producing livestock are to be met and various feedstuffs containing certain quantities of various nutrients are available at stated prices. The use of each feedstuff in the ration can be considered as an activity, and the cost of meeting the requirements can be minimized by selecting the activity levels in a particular way.<sup>4</sup> Some commercial

<sup>&</sup>lt;sup>1</sup>See, for example, Clifford Hildreth and Stanley Reiter, "On the Choice of a Crop Rotation Plan," included in Tjalling C. Koopmans, Activity Analysis of Production and Allocation, Cowles Commission Monograph No. 13, New York: John Wiley and Sons, 1951; Richard A. King, "Some Applications of Activity Analysis in Agricultural Economics," Journal of Farm Economics, December, 1953, pp. 823-33; and Earl R. Swanson and Kirk Fox, "The Selection of Livestock Enterprises by Activity Analysis," Journal of Farm Economics, February, 1954, pp. 78-86.

<sup>&#</sup>x27;See, for example, Frederick V. Waugh, "The Minimum Cost Dairy Feed," Journal of Farm Economics, August, 1951, pp. 299-310; Walter D. Fisher and Leonard W. Schruben, "Linear Programming Applied to Feed-Mixing under Different Price Conditions," Journal of Farm Economics, November, 1953, pp. 471-83 and I. Katzman, "Solving Feed Problems Through Linear Programming," Journal of Farm Economics, May, 1956, pp. 420-29.

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feed mixers employ this formulation and routinely select feedstuffs from the results of computations carried out within their own firms or by computing agencies which now have "canned" programs for solving such problems.

Certain marketing problems also can be expressed as linear programming problems. The selection of quantities to be shipped from various processing plants to various destinations can be so formulated. Similarly, programming of processing and storage activities can be, under certain conditions, formulated as linear programming problems.

It should be noted that with the linear programming model one can solve for the "rents" to the resources whose quantities are restricted. Thus, for various prices of products and the resources which can be purchased, appropriate land values, wage rates and interest rates can be obtained.

I do not consider linear programming to be a fad, and I expect its applications to be extended considerably. Thus far, the progress in linear programming has been in formulating the problems and in developing computational procedures. However, to be more useful than previous procedures, there must be reasonably good data describing resource and product relations. For problems such as that of programming shipments from sources to destinations, such data usually are readily available. But for production problems, such is not the case. Many of our applications have been illustrative, they have shown us what could be done if we had the data. An advantage of the linear programming formulation of production as compared with the classical formulation is that it permits direct use of certain technological information obtained experimentally. Workers in farm management can aid workers in the applied agricultural sciences in designing experiments which will yield more accurate estimates of technological relations. Also farm management records may be redesigned to obtain certain technological data.<sup>5</sup>

## Theories of Choice from Among Uncertain Prospects

Economists offering advice to businesses, consumers or government agencies on how to act now to achieve some given result in the future must deal with problems involving risk and uncertainty. The classic formulation of how to act in uncertain situations was that of Daniel Bernouli, although Knight, Hart, Tintner, and Stigler differentiated between risky and uncertain situations and offered explanations for the appearance of such a phenomenon as flexibility of production processes.

<sup>&</sup>lt;sup>5</sup> Although my remarks have been limited to linear programming, formulations in which the objective function is a quadratic one also have been made. Also, attacks have been made on problems in which the restrictions are not linear.

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Within the last decade, a widely acceptable model of behavior under uncertainty has been formulated, and the formulation includes elements drawn from a comparable conception of the statistical problem of how to make inferences from observed data. $^6$ 

Basically the problem is one of choosing a given course of action from among a number of possible ones, each of which has known outcomes for each of various possible "states of nature." The simple payoff-table of a game representation is an example of how the outcomes can be related to possible "states of nature." The course of action to be (or that will be) chosen depends upon (1) the preferences of the individual and (2) the kind of uncertainty with respect to the "state of nature."

If probabilities can be assigned to the various "states of nature," the expected value, variance, etc. of the payoff to any course of action can be determined. Given the utility function of the individual who will make the choice, a best course of action can be specified. If probabilities cannot be assigned, rules such as minimax can be applied. The minimax rule states that one should choose a course of action such that the gain is largest for the most unfavorable circumstances that can occur, i.e., one acts as if nature were going to act as unfavorably as possible. It is the belief of some persons that choosing according to this rule leads to overconservative behavior and that as a basis for making predictions the rule is of little value. Among the other rules that have been suggested are (1) maximax—choosing the course of action that would yield the largest gain for the most favorable behavior by nature, i.e., the chooser is as optimistic as possible with respect to how nature will behave; (2) minimax regret—choosing so that one minimizes the maximum difference between the outcome under the most favorable and least favorable conditions that can be provided by nature; and (3) some linear combination of minimax and maximax. Each of these rules is unsatisfactory when viewed from the standpoint of satisfying certain "reasonable" axioms about rationality in choice. Our notions of rational behavior and some of the rules for choosing under uncertainty simply are not consistent.

Regardless of the choice rule, the form of the choice can be that of a strategy—the specification of a function which states the relation between action at any time in the future and the information available at that time but not available when the strategy was chosen. Thus the theory is closely related to A. Wald's theory of sequential analysis of statistical data.

Applications of this formulation have been made to inventory problems and obviously can be relevent to farm management, marketing and agricultural policy. The optimal levels of stocks of various products

<sup>&</sup>lt;sup>4</sup>For a survey of the theory of choice refer to K. J. Arrow, "Utilities, Attitudes, Choices: A Review Note," *Econometrica*, Volume 26, 1958, pp. 1-23.

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and inputs held by the firm are important problems for farm producers and processors. Similarly, stock policy for raw materials is an important national question. Since the distribution of inputs among various alternative uses is a problem not unlike that of the distribution of stocks, production problems might also be treated in a similar way.

Life for the economist certainly was simpler when he had to be concerned only with theories that assumed prices and yields as given and that entrepreneurs wished to maximize profit. The formulation in the manner outlined above of problems in which uncertainty is present makes clear the need for knowledge about the source of the uncertainty as well as the preference system of the choice maker before advice can be offered. In the future farm managers and other economic consultants cannot state rules as simple as those we have been inclined to use, if the present drift of the theory is a promising one.

Somewhat related to theories of behavior under uncertainty and drawing more heavily upon related social sciences and some physical sciences are formulations of information processing within a firm and the optimal organizational arrangements. Traditional economic theory has ignored the costs of obtaining information about the environment (the demand for a product, production relations, etc.), processing such information and using it as the basis for making decisions. Yet, we know that business firms spend a good deal on such activities as market research, keep records of various kinds, etc. Also we know that some kinds of economic organizations need more information of certain kinds than do others in order to make given decisions.

The general framework of theories about information processing is one in which costs and values of knowledge about the environment are taken into consideration. Since the nature of the organization—as characterized by the degree of centralization, for example—affects the value of information, the optimal organization for a given environmental situation also can be specified.

To date, the models that have been constructed are very elementary ones. And the main result of speculation about organization has been to show the conditions under which decentralized decision-making is feasible, i.e., can yield eventually the correct equilibrium solutions. Consequently, we still do not have an adequate theory that can serve to help us to determine whether organizational problems and costs of information processing are limiting factors in determining the sizes of firms. Nor can we answer the question of whether a highly centralized economy such as that of Russia is inherently more or less efficient than

<sup>&</sup>lt;sup>7</sup> See Clifford Hildreth, "Problems of Uncertainty in Farm Planning," Journal of Farm Economics, December, 1957, pp. 1430-41.

 $_{\rm a}$  highly decentralized one. I venture no guesses as to when such questions can be answered satisfactorily.

#### Welfare Economics

Everyone who is concerned honestly with the effects of various economic policies upon that nebulous criterion "the general welfare" is concerned with welfare economics. However, during the past two decades, the term welfare economics has come to be associated with the conditions under which economic arrangements can lead to situations in which no individual in the economy can be made better off without making at least one other individual worse off. Such situations are known as *Pareto optimal* ones.

Considerable thought has been given to the conditions under which Pareto optimality can be achieved. In particular, some economists have been concerned with the conditions under which the equilibrium values for variables as established by market processes are compatible with Pareto optimality. To date, the list of these conditions includes absence of increasing returns in the economy and no external economies in production or consumption, i.e., the productivity of resources in one line of production must be independent of how much of other products is being produced and the utility of a commodity to one person must be independent of how much is being consumed by other persons. Furthermore, the usual welfare economics theorems imply infinite divisibility of commodities and that some of every commodity is being consumed by every consumer.

Recently, some of the theorems have been stated more generally to include certain cases of indivisibilities. Also some of the institutional arrangements that would make a market economy more readily capable of achieving Pareto optimality have been investigated. One result that may be of interest to agricultural economists is that the existence of futures markets for commodities can be conducive to achievement of a Pareto optimal result. Also, the existence of a market for insurance such as crop insurance makes the economic environment conform more closely to one in which Pareto optimality could be attained.

## Dynamic Theories

Much of economic theory is concerned with solving for the equilibrium values for certain variables—equilibrium values being those which would prevail of they were the initial ones and if nothing disturbed the system. In many instances, knowledge of such values is useful; in fact, such knowledge is the best that has been obtained. However, because time is required for variables to change and because the system is subject to

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various disturbances, we believe that these equilibrium values rarely would be observed, i.e., that the observed values are "chasing" the equilibrium ones. Marshall's classification of equilibria was an attempt to treat such situations. Theories of economic fluctuations are also designed to describe the paths of certain variables over time. The theories of production cycles in livestock and crops also can be considered as dynamic models in which relationships of variables at one point in time to variables at other points in time are introduced.

During the past two decades several different truly dynamic models of aggregate output for the economy as a whole—one might call them business cycle models—have been formulated. It is my opinion that as predictive devices these models are not highly satisfactory. This may be because there is fairly substantial component of economic behavior that, with present knowledge, is truly random in character. However, such models may tell us something about how various institutional arrangements can affect the amount of fluctuation that occurs—given that the source of such fluctuation is a random disturbance. Such results could not be obtained from purely static models.

Use can be made in statistical estimation of economic relations of the assumption that observed values need not be equilibrium values but that the speed with which a variable adjusts toward its equilibrium value is related to the difference between its observed value and the equilibrium one. Although the equilibrium values cannot be observed, their values can be estimated. One may thus obtain estimates of such relations as long-run demand and supply functions for various goods and services. In general, the estimated price and income elasticities of such functions will be greater than the estimates that have been obtained employing the assumption that observed values are equilibrium ones.

# Factor Price Equalization in International Trade

One of the truly original developments in economic theory is that pertaining to how resource prices are related to each other internationally when commodities can be traded but resource endowments are given in each country. Samuelson showed that under very special conditions including (1) a world of two countries each producing two commodities with two resources, (2) identical production functions in each country, the production function for each commodity being a Cobb-Douglas with constant returns to scale, (3) different ratios of the quantity of one resource to that of the other in the two countries, (4) trading in both com-

<sup>&</sup>lt;sup>8</sup> See for example Marc Nerlove, "A Note on the Long-Run Automobile Demand," The Journal of Marketing, Volume 22, 1957, pp. 57-64 and "The Implications of Friedman's Permanent Income Hypothesis for Demand Analysis," Agricultural Economics Research, Volume 10, 1958, pp. 1-14.

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modities between the two countries and (5) absence of transport costs or artificial barriers, factor prices in the two countries would be equal at equilibrium.9 Some of these conditions were relaxed subsequently by Samuelson10 and by McKenzie.11 The factor price equalization theorem, in its present form, requires that countries have available the same techniques of production, that there be constant returns to scale and that transport costs and tariffs be zero, but it does not require that every country produce and trade some of each product and it is not restricted to the two country, two commodity, two resource situation.

Although the conditions for factor price equalization are special ones and claims about what one could expect to occur if these conditions were not fulfilled have not been made, the results are startling ones. Further work may show that our conjectures about how to encourage economic development have been too narrow. In particular, improvement of technology may be the important factor. Also, we may need to revise our conjectures about how the gains from international and interregional trade might be split among the recipients.

## Theories of Income, Employment and the Price Level

The remaining class of theories on which I wish to comment includes those generally referred to as macroeconomic theories in that they are concerned with certain features of the economy as a whole—the level of gross national product, employment, an index of prices, and an index of the rate of interest, for example. Although the quantity theory of money can be considered such a theory and has been widely employed for many years, major impetus to recent developments in macroeconomic theory was provided by Keynes', The General Theory of Employment, Interest and Money. In fact, many persons refer to such theories as "Keynesian theories" even though some of them differ markedly from the initial one of Keynes.

Basically these macroeconomic theories are static theories, i.e., they are concerned only with the equilibrium values for certain variables. They are also general equilibrium theories in which the economy is divided up into several different markets—usually a market for final goods and services, a market for securities, a market for labor and a market for money-and solutions which satisfy the conditions for equilibrium in all markets simultaneously are obtained. Because there is still fundamental

Equalization Once Again," Economic Journal, Volume 59, 1949, pp. 181-97.
"Paul A. Samuelson, "Prices of Factors and Goods in General Equilibrium,"

Paul A. Samuelson, "International Trade and the Equalization of Factor Prices," Economic Journal, Volume 58, 1948, pp. 163-84 and "International Factor-Prices

The Review of Economic Studies, Volume 21, 1953-54, pp. 1-20.

"Lionel W. McKenzie, "Equality of Factor Prices in World Trade," Econometrica, Volume 23, 1955, pp. 239-57.

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disagreement among economists with respect to the appropriate economic policy to follow in order to avoid wide fluctuations in income, and some of the disagreement is the result of differences in theories employed, I shall try to describe briefly some of the characteristics of certain classes of macroeconomic theories.

One can obtain from most macroeconomic models a relation between the price level and the quantity of goods and services that buyers would be willing to take from the market. This relation is such that conditions for equilibrium in the market for goods and services, the money market and the securities market all can be fulfilled. Such a relation might be termed an aggregate demand schedule. Its location depends upon such things as how consumers, businesses, governmental units and the monetary authority behave, the distribution of income, etc., the precise list of relations depending upon theory. Similarly, there is an aggregate supply schedule-a relation between the price level and the most profitable amounts of goods and services to produce, given the behavior of workers, the amounts of other productive resources, the technology, the degree of monopoly, etc. The point of intersection of these two curves-if one exists-denotes the price level and the amount of real gross national product that will fulfill the conditions for equilibrium in all markets simultaneously. I believe that it will be informative to talk about some of the different theories in terms of the aggregate demand and supply relations implied by each.

The classical economists assumed that both the demand for and supply of labor depended only upon the real wage. This assumption yields an aggregate supply relation for goods and services that has zero price elasticity, i.e., there is a single level of real gross national product that will result in equilibrium in the labor market. Keynes assumed the "true" behavior of workers and employers to conform to the classical assumptions. However, other of his assumptions yielded an aggregate demand relation such that no point contained in it need be contained in a classical supply relation; hence, for less than full employment, Keynes assumed the supply of labor to depend upon the money wage. Consequently, aggregate supply of goods and services is not price inelastic. In effect, the labor market is truly out of equilibrium in order that equilibrium might prevail in other markets. Some current theories of "cost push" inflation employ an analogous assumption about the labor market. In other theories which assume wage flexibility, the aggregate supply of goods and services will not be price inelastic because of the effects of price level changes upon the real wealth positions of both laborers and entrepreneurs and their consequent effects upon the quantity of labor demanded and supplied at any level of real wages. In such formulations, there is not a single value for full employment as is characteristic of the classical theories as well as the Keynesian theory.

The differences in assumptions about the spending behavior of various economic units lead to different implications with respect to the nature of aggregate demand, and these differences in the nature of aggregate demand are crucial in accounting for policy differences. In the crude version of the quantity theory of money the location of the aggregate demand relation depends only on the quantity of money in circulation, and this demand function has a price elasticity of unity. If buyers won't purchase some given quantity of goods and services at some price level, they will at a lower one. At the opposite extreme, if real spending depends only on real income, the price elasticity of aggregate demand is zero. Wage reduction will only lower the price level. It will not increase employment. And the quantity of money has nothing to do with either prices or employment. Changes in government spending or in the tax system would be needed to shift the demand relation. Although few persons would admit belief in such a theoretical system, many act as if they employed one in their economic policy proposals.

The macroeconomic model of *The General Theory* is one in which price level changes may affect the quantity of goods and services demanded via their effects upon the rate of interest. However, a minimum rate of interest also is assumed so that aggregate demand is price inelastic for any price level equal to or below a certain value. And monetary changes may be powerless in increasing total expenditure, although they may always

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supingle If the assumption that one's spending depends upon his wealth and that wealthy persons generally spend more of a given income than do poor ones, some interesting implications emerge. Since the public will be in a net creditor position as long as government debt is positive, price level increases will make private buyers poorer and hence cut the real quantity of goods and services purchased. Since a portion of wealth is capitalized income, short-run income changes will have less effect upon expenditures than long-run changes. In fact, for incomes that fluctuate widely—as do certain farm incomes—there may be little relation between income and spending. And, insofar as persons expect economic growth, a given proportionate decrease in income will be accompanied by a smaller proportionate change in spending than will be associated with the same proportionate income increase. Economic growth will, in itself, increase the level of spending at any given level of income and economic stagnation need not be considered a problem.

<sup>&</sup>lt;sup>13</sup> See Milton Friedman, A Theory of the Consumption Function, National Bureau of Economic Research, 1957.

The recent speculation with respect to macroeconomic theories has been such as to give the aggregate relationships a firmer foundation in individual economic behavior. It also should have the effect of demonstrating conclusively that in an economy in which prices and interest rates are free to adjust, equilibrium at full employment is always possible without intervention, although full employment is not a unique figure. Static theories will not tell us how rapidly adjustments will take place under various conditions and consequently shed little light on whether discretionary monetary or fiscal action to counter certain disturbances is desirable. Also, the degree of aggregation characteristic of most static macroeconomic models has been too great to answer many questions of interest to agricultural economists. Tax changes, wage changes, etc., do not affect all sectors of the economy in the same manner and it would be of interest to note these differential effects. In principle, there is no great difficulty that inherently prevents disaggregation except the larger number of variables with which one must work. After all, Walras constructed such a system more than three-quarters of a century ago.

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#### Summary

I have sketched some developments in the theory of individual economic choice—many of which are currently being employed by agricultural economists—and have indicated some of the work that has taken place or is in progress in areas applicable to agricultural economics. It should be pointed out that agricultural economists have contributed to some of these developments. I believe that no revolutionary developments have taken place—at least insofar as guides to economic policy are concerned. Perhaps this is demonstrated as well in the field of farm policy as in any other area. Marshall's *Principles* would be as adequate as any other body of doctrine to consult in formulating a good agricultural policy. Many recent developments prove rigorously propositions that had been previously stated or make the derivation of propositions easier to understand.

#### MEANS FOR MAINTAINING ECONOMIC STABILITY

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ENERALLY, when we talk about economic stability, the central variable attracting attention is the level of unemployment. (We, of course, prefer a low level of unemployment rather than a stable quantity at any other level.) Secondarily, we may be interested in stabilizing price levels. Other variables, such as per capita income, employment and national product are expected to grow rather than remain stable. I will, therefore, focus on the problem of stabilizing unemployment at a low level.

A variety of means, ranging from fiscal, monetary, and tax structure policies to price and wage controls of either the administered type or the market type (control of prices and wages by competitive market forces), may be used to keep unemployment low. Since we usually have other ends in view in addition to minimizing unemployment, we generally prefer means other than administered price and wage controls as a method of holding down unemployment. Conscious controls produce unwanted consequences such as misallocation of resources and decreased freedom of choice. Also, the political process being what it is, administrators are likely to change prices and wage rates in ways which cause unemployment rather than prevent it.

## The Causes of Unemployment

We can look for the causes of unemployment and the means for preventing it, in two main areas. (1) Exogenous factors act on the economy in ways which may tend to cause declines in employment. (2) Since sufficiently rapid adaptations of prices and wage rates can offset external factors, failure of the adaptive mechanisms of the economy to react rapidly enough may also be regarded as a cause of unemployment.

Sufficient flexibility in prices and wage rates can prevent unemployment in the face of adverse conditions. We must also recognize that prices and wage rates may be moved to levels which cause unemployment despite conditions which otherwise favor increased employment. Measures such as the National Industrial Recovery Act and the Agricultural Adjustment Act of 1933 increased wage rates and prices and consequently increased unemployment from 9 million at the time they began operating to 12 million a few months later. This occurred at a time when other factors would have decreased the number of jobless but for these offsetting actions.

The external factors acting on the economy include such forces as

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monetary policy, technological change, consumer tastes, the tax structure, and weather. Among these, it is only monetary policy which is the major problem. Adaptive reactions in the economy adequately cope with the other forces. Generally, unemployment caused by these variables in combination seldom goes as high as 3 million, or 5 per cent of the work force. In the case of changes in monetary policy, however, we find that adaptations in prices, and, particularly, wage rates, lag changes in the monetary sphere. As a matter of fact, wage rates seem to move adversely at the very time that monetary forces also behave adversely. Both tend to act together to compound the unemployment problem.

## Monetary Changes and Unemployment

Research by members of the workshop in money and banking at the University of Chicago suggests that turning points in the rate of change in the money supply precede turning points in business activity<sup>2</sup> and in velocity of circulation. Stability in the money supply growth rate would lead to greater stability in velocity. The combined stability of these two items, which determine the rate of spending, would lead to greater stability in the economy.

The Federal Reserve Board (FRB) has an unofficial rule of thumb that the money supply should be allowed to grow about 3 per cent per year. The rule, however, is not observed. Prior to 1956, the money supply grew more rapidly than 3 per cent. Following the period of rapid growth, the rate of increase was held to an annual level of less than 1 per cent. After July, 1957, the quantity of money actually declined (on a seasonally adjusted basis).

I would suggest that the FRB could have contributed greatly to the moderation of the recent contraction if it had taken steps at least five months before the rediscount rate cut of November, 1957, to prevent the decline in the quantity of money. Even with the delay, the board could still have done much better than it has done. The steps taken prior to March of this year were nominal. Federal Reserve bank credit furnished in the first two months of this year, before the cut in reserve requirements, was running approximately one-half billion dollars below the levels of the previous year. This certainly was no contribution to the

<sup>&</sup>lt;sup>1</sup> For a discussion of the amount of unemployment resulting from technological change, see Y. Brozen, "Automation: Creator or Destroyer of Jobs," *Iowa Business Digest*, February, 1956.

<sup>&</sup>lt;sup>2</sup> Clark Warburton's work has also demonstrated this point, although he relates the quantity of money to departures from trend rather than examining rates of change. "The Misplaced Emphasis in Contemporary Business Fluctuation Theory," The Journal of Business of the University of Chicago, October, 1946.

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 $_{\mbox{\scriptsize problem}}$  of minimizing unemployment, particularly in view of the gold  $_{\mbox{\scriptsize drain}}$  occurring at the time.

Monetary action has been the cause of the deflations of the past which initiated employment declines. The decrease in the quantity of money by 16 per cent in 1920 was the direct result of Federal Reserve policy beginning with the actions of November, 1919. Further steps were taken up to the middle of 1920 to squeeze the economy<sup>3</sup> in spite of the fact that a downturn in economic activity began in January, 1920.

The 1929 to 1933 decline came from a mixture of causes with monetary authorities contributing a full measure to the deflation of the quantity of money by 27 per cent. The 1937 descent into depression was preceded by increases in required reserve ratios in August, 1936, and in March, and again in May, 1937. As a result, the quantity of money declined continuously throughout 1937 and the first four months of 1938. The turning point did not come until reserve requirements were reduced in April, 1938.

In the postwar period, each of the recessions has been preceded by actions on the part of monetary authorities which reduced the rate of growth or decreased the supply of money. The drop in employment which began in late 1948 was preceded by increases in required reserve ratios in February, again in June, and once again in September. These increases forced a decline in the quantity of money.

The 1953-54 recession was preceded by a period of monetary stringency which was strongest in May, 1953. This recession, however, was as much a consequence of the rapid increase in real wage rates between the third quarter of 1952 and the third quarter of 1953 as of monetary policy.

As may be noted in Table 1, the quantity of money did not decrease between mid-1953 and mid-1954. However, the rate of growth was less than three-fourths of 1 per cent as compared to a growth rate of over 2 per cent in the preceding year. The wage rate and price increases of the previous year were incompatible with full employment in the following interval of slower growth in the money supply, particularly in view of the decline in quantity of money per capita.

The just-past recession stems in part from the reaction of the FRB to its own policies which it instituted to cure the 1953-54 decline. Reserve requirements were reduced in June, 1954. The unemployment peak had already occurred in March, 1954. By June, the action was hardly necessary. A much smaller cut, or moderate open market op-

<sup>&</sup>lt;sup>3</sup>Robert F. Wallace analyzed the especially onerous effect of Federal Reserve policy on agriculture in "The Use of the Progressive Discount Rate by the Federal Reserve System," *Journal of Political Economy*, February, 1956.

TABLE 1. VOLUME OF MONEY AND UNEMPLOYMENT

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Year	Money in Circul	Unemployment <sup>c</sup>		
	(billions)a	(per capita) <sup>b</sup>	(June) (millions)	
1920	\$ 23.7	\$223	0,	
21	20.8	192	4.	
1929	26.2	215	_	
30	25.1	204	0.3	
31	23.5	189	4.9	
32	20.2	162	10.3	
33	19.2	153	11.1	
1937	30.7	238	4.5	
38	29.7	229	9.0	
1948	108.3	739	1.8	
49	107.1	718	3.3	
1953	124.3	779	1.6	
54	125.2	771	3.3	
1957	135.2	790	3.3	
58	133.5	767	5.4	

\* Federal Reserve Bulletin, various issues.

<sup>b</sup> Computed using population data from *Historical Statistics of the United States*, Washington: Government Printing Office, 1949, and *Current Population Reports*, Series P-25, Washington: Bureau of the Census, June, 1958.

<sup>o</sup> For data prior to World War II, Economic Almanac, New York: Thomas Y. Crowell Co., 1953-54, p. 423. Data for 1920 and 1921 are average unemployment during those years. For data after World War II, Survey of Current Business, various issues, Washington: Department of Commerce.

erations, would have meant a less rapid growth in the money supply in the latter half of 1954 and in 1955. With a more moderate growth rate in this period, the inflation which alarmed the FRB in 1956 and 1957 would not have occurred. The board would not have felt it necessary to slow the growth in money supply but for the high rate of growth earlier. Without this slowing (and the actual fall in the quantity of money after July, 1957), we would not be confronted with the volume of unemployment now concerning us in the United States.

# Real Wage Rates, Productivity, and Employment

We can plausibly argue that the unemployment we suffer, and have suffered, is a consequence of administered prices and wage rates, given the monetary circumstances described above. Some of these prices are administered by governmental authorities; others by private authorities.

Many wage rates are set by governmental authorities such as the minimum rates for employees of enterprises in interstate commerce and of those producing goods under contract with the United States govern-

ment. Others are set for long periods in advance by negotiations between employers and unions. This year, for example, 4.5 million workers in the United States have received, or will receive, wage increases under contracts negotiated in prior years when 1958 economic circumstances and markets were but imperfectly known. Most of these increases are occurring in industries suffering severe unemployment, such as steel and rail-roads.

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TABLE 2. MOVEMENT OF PRODUCTIVITY, WAGE RATES, AND UNEMPLOYMENT

Year	Real Hourly <sup>a</sup> Earnings (Manuf.) (47-49\$)	Per cent Change	Average <sup>b</sup> Productivity (Private Nonfarm Sector)	Per cent Change	Relative Per cent Change	Unemployment <sup>o</sup> (millions)
1929	\$0.772	~	\$1.51	~	~	0.4
33	.799	+3.6%	1.46	-2.9%	-6.5%	11.8
1936	.94		1.63			7.4
38	1.04	+10.7	1.68	+2.8	-7.9	9.8
1948	1.313		2.06			2.1
49	1.376	+4.8	2.14	+4.0	-0.8	3.4
1949	1.376		2.14			3.4
50	1.425	+3.6	2.25	+5.2	+1.6	3.1
1952	1.47		2.36			1.7
54	1.58	+7.5	2.51	+6.0	-1.5	3.2
1956	1.70		2.62			2.6
57	1.74	+2.3	2.67	+1.8	-0.5	2.9

<sup>a</sup> The Economic Almanac, 1958, New York: Thomas Y. Crowell Co., 1958, p. 253.

b J. W. Kendrick, National Productivity and Its Long-Term Projection (unpublished, May 1951) and Economic Report of the President, Washington: U.S. Government Printing Office, 1958. Data from the latter used to compute the measures of productivity from 1949 through 1957.

Historical Statistics of the United States, Washington: U.S. Government Printing Office, 1949, for data through 1938. Data for the postwar period are from Economic Report of the President, op. cit.

The relationship between wage rates and unemployment is such that these 1958 changes work in a destabilizing direction. They will add to the number of unemployed, at least in the sense that more people will remain unemployed than would have if no wage rate increases were to occur. They partially offset the employment increasing effects of present fiscal and monetary policies, some of which have automatically come into operation and others of which are the result of discretionary actions.

This is not the time to attempt a proof of the proposition that other

<sup>&</sup>lt;sup>4</sup>M. Friedman, "Why the American Economy is Depression-Proof," National-ekonomiska Föreningens, April 28, 1954, describes some of the automatic stabilizers referred to here.

things being equal, the number of jobs is inversely related to the wage rate. I would like to point to data which illustrate the point that increases in real wage rates which outrun increases in productivity are frequently associated with an increased volume of unemployment. Purchasing power is determined by factors other than money wage rates.

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Between 1929 and 1933, real wage rates in manufacturing rose relative to average output per man hour by 6.5 per cent. This was associated with a rise in unemployment in the United States of those people who would normally be employed from 0.4 million to 11.8 million. Between 1936 and 1938, real wage rates increased almost 8 per cent more than productivity, and unemployment averaged 10.4 million in 1938. (Among those who would normally be a part of the labor force, unemployment was 9.8 million).

In the various post-World War II recessions, we find similar experiences. The rise in real wage rates outran the average output rise between 1948 and 1949 by about 1 per cent, and unemployment increased by 1.3 million. From 1952 to 1954, real wage rates increased about 1.5 per cent more than productivity, and unemployment increased by 1.5 million. Between 1956 and 1957, the rise in real wage rates was 0.5 per cent greater than the average output rise, and unemployment increased by nearly 0.5 million. On the other hand, real wage rates increased less than output per man hour from 1949 to 1950 and 1951. Unemployment declined in these years.

I should warn you that average output is not a proper measure of the level of wage rates compatible with full employment. We should use marginal productivity of the total labor force. If average output were highly correlated with marginal productivity, we could expect that changes in the average would be a guide to changes in marginal output and, therefore, a guide to changes in wage rates consonant with the maintenance of employment. This has been implicitly assumed as true over short periods in the preceding discussion.

Over long periods, we would expect that increases in average output per man caused by a rising supply of capital would be less than changes in marginal output. We would, therefore, expect wage rates to increase by a larger proportion than average output over long periods if an increased supply of capital and capital-saving technological change were the dominant forces at work. In fact, we do find that real wage rates rose by 120 per cent between 1929 and 1956, while average output rose by only 74 per cent. Yet 1956 was as good a year in the employment sense as 1929. Changes in average output over long periods are a poor guide to the proper amount of change in wage rates, but may serve well for determination of changes over short periods.

## Why Real Wage Rate Increases Outrun Productivity

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It would seem that a method of stabilizing unemployment at a low level would be one which prevents real wage rates from moving by amounts which are too far out of line with productivity changes. Let us then look at the factors which have caused movements in real wage rates relative to productivity which are incompatible with a low level of unemployment. From this we can draw inferences concerning the means for maintaining economic stability.

From May, 1919 to October, 1920, money wage rates in manufacturing rose by 25 per cent. The peak in business activity occurred nine months before the peak in wage rates. The peak in product prices preceded the labor price peak by five months. This lag in the turn in money wage rates is a typical phenomenon. The National Bureau of Economic Research found an average lag behind manufacturing activity of nine months in the United States and 11 months in the United Kingdom in its study, Behavior of Wage Rates During Business Cycles. In the railroad industry the lag averaged 19 months.

The period after a downturn in business activity before wage rates turn is usually a period of less rapidly rising, or declining, productivity. Real wage rates continue to rise, however, in such periods. (The real rate rise is the result of a continuing rise in money wage rates and a downturn in prices preceding the downturn, if any, of money wage rates.) The movement of real wage rates acts in this period, therefore, as a destabilizing factor. The downturn would be damped if money wage rates were to fall, or at least cease rising sooner. A reduction in the time lag would be an important means of maintaining economic stability. We will return to this point.

Real wage rates rise relative to productivity in the period preceding downturns in business activity, thus leading to the fall-off, as well as in the period following the turn in activity when the continuing rise serves to further the descent and worsen the slump. From the third quarter of 1952 to the third quarter of 1953, for example, real wage rates increased by 5 per cent, while productivity increased less than 4 per cent. In 1957, straight-time money wage rates increased by 4.5 per cent while the wholesale price index for nonfood items increased less than 1 per cent, and productivity increased less than 1 per cent. The greater severity of the current contraction may be attributed to the fact that larger increases in productivity moderated the effect of real wage rate increases in the period preceding the previous downturn.

The severity of the 1937-38 decline may also be attributed in part to the wage rate increases in the preceding period. Between October, 1936, and May, 1937, money wage rates in manufacturing were pushed from 62

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cents to 70.1 cents per hour despite the still sizable volume of unemployment. This 13 per cent rise in wage rates in the face of a slowing in the growth of the money supply shot unemployment from a less than 5 million level before mid-1937 to nearly 12 million by early 1938.

The rise in periods such as these is frequently blamed on unions. Whatever merit there is to this argument, the fact remains that employers are less resistant in their bargaining in the late stages of a boom. Rates in nonunionized industries and in nonunionized periods in history seem to behave similarly. Anticipation of continued increases in productivity and prices—increases which occur at unusually good rates in the early stage of an interval preceding a turn in activity—lead to overbidding for labor.

The overbidding occurs at a time when few idle men are available at current wage rates. Additional men can be obtained only by outbidding other employers. Perhaps the overbidding may be caused by the same reactions which lead to overpricing occasionally in speculative markets. Less aggressiveness on the part of unions, or less power in their hands, might lessen the problem. The pattern, however, seems to stem largely from mistaken anticipations concerning the future worth of labor and the worth of product from present labor which will reach the market in the future.

## Means for Maintaining Economic Stability

Part of the reason for the rise in real wage rates relative to productivity in periods such as 1920, 1930-33, 1937, and 1949 lies in the fall of product prices. Our attention should then be directed toward the problem of preventing this decline.

Changes in the rate of growth of the money supply are primarily responsible for the fall of prices and, secondarily, for the rise in real wage rates stemming from this type of occurrence together with continued increases in money wage rates while activity is declining. Any decrease in the rate of growth of the money supply sets the stage for a decline. The lags in our economy are such that the adjustments made to a growing money supply are not compatible with full employment in the following periods if the money supply does not continue to grow as rapidly.

This suggests that monetary authorities must use caution in allowing high rates of growth at any time if they intend to slow the growth later to prevent inflation. It is wiser to use more moderate means to remedy recessions of the 1953 variety, for example, then the cuts in reserve requirements of the amount made in June, 1954.

Rather than attempting to meet various exigencies as they arise by discretionary monetary action, monetary authorities would be better advised to maintain a stable rate of growth in the quantity of money at, let us say, 2 per cent per year, or, perhaps, 3 per cent. In any event, there

should be no shifting in monetary policy from time to time in order to accelerate or slow the rate of growth.

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Although greater consistency in monetary policy would do the major part of the job required to stabilize unemployment at low levels, we must face the fact that there may be monetary instability at various times as long as politics and human beings influence the devising and execution of monetary policy. In order to minimize the harm that may be done by unwise policy, the adaptive mechanism of our economy must be made more responsive.

The second factor, then, to be considered in devising means for stabilizing the economy is the lag in turnabouts of wage movements behind turnabouts in business activity and employment. We cannot attribute the lag simply to the presence of labor unions. Wage rates lagged when the union movement was unimportant in the United States, as well as in the period since it has become a much stronger force in the economy. It is significant, however, that wage rates apparently begin moving upward much sooner in periods of expansion than they formerly did when unionization was less widespread. This tends to slow the recovery process. Furthermore, the lag has been much longer in the railroad industry which was highly unionized long before the unions grew strong in most other industries.

The paramount problem here seems to be one of restraining the continuance of an upward wage rate movement after employment has turned down. Two devices might be suggested which would help provide a solution. One is that employers should insist on escape clauses in long-term agreements which provide for future wage rate increases. If production in the two months prior to a time when a wage increase is due is down 10 per cent below the level of the similar period in the preceding year, then an escape clause should provide that wage increases would not go into effect.

Just last month, industries whose production is down 20 to 40 per cent were putting higher wage rates into effect. The steel industry, for example, was required by its contracts to institute 9 cents-an-hour improvement increases plus 4 cents-an-hour cost-of-living increases, plus fringe benefits which increased wage costs by a total of 16 to 19 cents an hour. Similarly, the aluminum industry was required by its contracts to increase employment costs by 24 cents an hour.

A second device would be to bring labor monopoly within the range of the Sherman act, limit the size of collective bargaining units, and make collusion among them unlawful. The case for such action has been explored and the legislative changes required delineated by H. Gregg Lewis in "The Labor-Monopoly Problem: A Positive Program." (Journal of Political Economy, August, 1951.)

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Both of these devices still leave untouched the reluctance of employers to cut wage rates after a downturn, or their willingness to grant increases at times of declining employment and sales. Here we need more information on what happens and why. Economists have engaged in speculation on this point. Rather than suggest measures based on such speculation, however, it would be wiser to find out more about the reasons for the occurrence of the phenomenon. Whether it is social pressure, fear of effects on morale and productivity, inability to diagnose the current situation, or the human failing expressed in the phrase that "generals always prepare to fight the last war," we do not know.

Perhaps business men should be taught to pay attention to quit rates and qualified applicant rates before determining whether or not to raise a wage rate. Voluntary quit rates have always sunk to very low levels months before the community became aware that a recession was under way. Simply because a wage increase was required last year, and each year before, to hold employees is not an indication that another is currently required.

Perhaps the community and employees must be taught that an employer who cuts wage rates, or fails to give a wage increase in times of declining business, is performing a social service and maintaining employment by doing so. There is some evidence that workers and the public at large are not unaware of this. Polls of workers in the Flint, Michigan area indicate that they would prefer jobs and greater assurance of job continuity, to increases in wage rates at this time. A preponderant majority of those sampled in a nation-wide poll expressed similar opinions.

It may be that recurrent wage increases are granted as a means of simplifying the decision-making life and providing administrative ease for managers. Other rules of thumb for granting wage increases may have to be devised to conserve decision-making capacity and avoid administrative unease, and at the same time function to produce the adaptations required for a stable economy.

#### DISCUSSION: IMPLICATIONS TO FARM POLICY

DAVID L. MACFARLANE
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The first of my tasks is to answer the question: What are the implications of recent developments in economic theory to farm policy? Brownlee has done a commendable job of bringing a vast amount of work in economic theory within the compass of a few pages. He states: "I believe that no revolutionary developments (in economic theory) have taken place—at least insofar as guides to economic policy are concerned. Per-

haps this is demonstrated as well in the field of farm policy as in any other area. Marshall's *Principles* would be as adequate as any other body of doctrine to consult in formulating a good agricultural policy." Thus, if I am to comment on the significance of developments in economic theory over the past 20 to 25 years to farm policy, I must go it alone.

I would ask if those workers who over the past two decades have done the best work in the field of agricultural policy could have made as imnortant contributions if they were limited to employing guides provided in Marshall's Principles. Could Schultz convincingly state, aided only by the Principles, with respect to the problem of maintaining the stability of the economy, that monetary-fiscal "control can and should play a dominant role?" Do we not now think about a more important range of problems relating to income, employment, and the price level, and do we not have the capacity for keener insights? Can we not agree with Boulding that "It is no exaggeration to say that the past twenty years have brought a great increase in understanding the problem of depression. At the very least it should result in a corresponding increase in the ability to take intelligent measures to prevent it." Boulding proceeds to make generally comparable statements about managing inflation or what he terms "over-consumption" or "over-absorption" in his most recent book. I accept this position and thus feel Brownlee's charges about the limited contribution of recent developments in theory are too strong. In fact he admits, and here I quote Brownlee, that ". . . there have been some developments (in economic theory) that have changed markedly the thinking about certain kinds of problems." And I would include in these problems some considerations in the field of agricultural policy as having been subject to marked change in thinking.

Brownlee states that ". . . there is still fundamental disagreement among economists with respect to the appropriate economic policy to follow in order to avoid wide fluctuations in income, and some of the disagreement is a result of differences in the theories employed . . . ." I prefer Boulding's position, stated as follows:

If the head of any non-communist government were to ask his economist advisers what to do about inflation, or about a depression, and even in a smaller degree about economic development, he will get much the same answers. There will be local variations and individual differences but by and large economists speak the same language and give much the same kind of advice no matter where they are.<sup>3</sup>

Current thinking on agricultural policy has been influenced by work

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<sup>&</sup>lt;sup>1</sup>T. W. Schultz, "Coping with Agricultural Abundance," Farm Policy Forum, Winter 1958, p. 15.

<sup>&</sup>lt;sup>1</sup>Kenneth Boulding, The Skills of the Economist, Toronto: Clark, Irwin and Co., Ltd., 1958, p. 114.

<sup>\*</sup>Ibid., p. 129.

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in the development of interindustry input-output analysis and by research relating to imperfect competition. Perhaps Brownlee would not include them in areas where there have been significant developments in economic theory. Work in the first of these subjects has given an improved understanding of the relation between agriculture and other segments of the economy. The latter has been used not only in evaluating the effects of production restriction schemes, but more particularly in appraising marketing programs. There are also policy implications (in the work of Heady and others) on the characteristics of production functions in agriculture, on guides to resource use, and on the conditions required to improve efficiency in agriculture. All of these depend in some measure on developments in economic theory. This is not to disagree wiith Brownlee's statement that there have been no revolutionary developments in theory. But because a field does not move ahead in giant strides in no respect means that it does not move. I like Hildreth's view that practical knowledge depends on theoretical developments. He states with respect to problems of decision-making under conditions of uncertainty that:

. . . we have a variety of scattered suggestions and a few well-coordinated but not entirely satisfactory theories which relate to special aspects or kinds of uncertainty, or to particular ways of viewing uncertainty. These give fragmentary insights but leave many perplexing problems. . . . Theories can continually be reformulated and extended and such ideas as are available at any time can be applied to empirical problems. Most such applications are necessarily crude and the results are themselves uncertain. Our willingness to use the practical implications depends at least as much on judgment as on the manner in which the implications were derived. . . . Crude applications can still be carefully conducted and can contribute tests of some assumptions underlying our theories, hints for possible future developments, and some new insights into practical problems.4

I feel that this significant statement may be generalized to other ques-

tions of concern to agricultural policy.

Turning to Brozen's paper there is convincing argument that the general level of economic activity, and specifically unemployment, are closely related to the quantity of money. With monetary policy given, he finds unemployment reflects rigidity in prices and in wage rates. He is properly critical of union contracts which fix wages for long periods—in effect projecting the economic environment in which the contracts would be carried out. Faced with these lags, stability in the economy may be promoted if the monetary authorities "maintain a stable rate of growth in the quantity of money." This conclusion appears to depend unduly on an oversimplified single-variable explanation of fluctuations in economic

<sup>&</sup>lt;sup>4</sup>C. Hildreth, "Problems of Uncertainty in Farm Planning," Journal of Farm Economics, December, 1957, p. 1430.

activity. We would seem to be well-advised to give greater consideration to such factors as interest rates and the velocity of circulation, particularly as they may be affected by economic expectations. As Villard has stated.

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... it is the factors determining the use of a stock of money more than adequate to meet current or prospective requirements that have become of primary importance in recent year. . . . theoretical analysis has increasingly concentrated on setting forth both the determinants of the flow of spending and the effect of the resulting spending on output and employment, rather than the changes which the quantity of money could be expected to have on the limit of prices under conditions in which it could be assumed that income velocity would be relatively constant and output at about the highest level permitted by our labor force and plant facilities.5

Few would disagree with the need for parallel consideration of fiscal policy-which, operates, after all, on the same economic variables.

With respect to the relationship between fluctuations in the economy and farm prices and incomes, I would cite approvingly Doll's statement, "Any effort made to solve the problems confronting the agricultural sector of the economy through the use of general monetary policy would, in all probability, lead to conflict and, ultimately, to chaos. Many students of agricultural economics, therefore, contend that the best monetary policy for the agricultural sector is one that will encourage orderly growth at relatively stable price levels for the general economy." However, this should be qualified to indicate that as agriculture becomes less important relatively in an economy, farm prices seem to be less sensitive to general inflationary conditions. We might say that in recent years the behavior of farm prices shows a sensitivity to excessive supplies.

In terms of systematic organization and in terms of providing a most meaningful orientation of the problems of farm policy, I know of no more satisfactory work than that provided in Part III of T. W. Schultz's Economic Organization of Agriculture. The point I should like to make, and it seems relevant to our discussion today, is that Schultz admitted dependence on a wide range of theoretical ideas which, if not original to the past 20 to 25 years, certainly have been developed over that period of time. He admits his debt to Macfie, Arrow, Koffsky, Heady, Hart, Samuelson, Friedman, Wallace and many others whose major contributions have been in the area of economic theory. I conclude, not only that we employ the results of developments in economic theory of the past 25 years, but that in consequence we do a better analytical job.

<sup>&</sup>lt;sup>5</sup>Henry H. Villard, "Monetary Theory," A Survey of Contemporary Economics, Philadelphia: Blakiston Co., 1949, p. 320.

Raymond J. Doll, "Some Implications of Monetary Policy on Agriculture," Journal of Farm Economics, February, 1958, p. 21. 'New York: McGraw-Hill, 1953.

#### DISCUSSION: IMPLICATIONS TO FARM MANAGEMENT

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ROY E. HUFFMAN Montana State College

The papers by Brownlee and Brozen outline many of the contributions of the social sciences to change and adjustment and also cite where, in the opinion of these two economists, several theories, policies and programs have not attained their intended goals. My discussion of the implications of these matters to farm management will be divided in two parts; (1) the implications to farm or ranch operators as they make decisions related to the resources available within their unit boundaries, and (2) the implications to farm and ranch operators as they make decisions related to economic and other forces from outside the operating unit.

In my opinion, it is important to note before proceeding further that the rapid rate of technological change both in and out of agriculture has been a major factor in determining the effectiveness of the social sciences in helping agriculture to make necessary adjustments. Brownlee says that there have been no "bold strides" in economic theory for about the last quarter-century or more. I would like to think that, at least, we are able to better apply the available theory. Brownlee, in discussing dynamic theories, suggested that "the observed values are 'chasing' the equilibrium ones." I agree that economic predictions with respect to problems of agricultural production are concerned with a moving target of increasing speed and an uncertain course. The value of economic theory and the predictive process to farm management will be increased greatly if we can "lead" the target and not merely follow it. This is obviously difficult and may appear impossible. It is necessary, however, to make some assumptions regarding the nature, direction, and speed of technological changes as the basis for recommended adjustments. Brozen discussed the Federal Reserve Board's rule of thumb that the money supply be allowed to grow about 3 per cent each year. It may not be possible to establish rules of thumb regarding the impact of technology over time on such factors as the labor requirements and production potentials for agriculture in the aggregate and for individual commodities. But it is essential that we do better than to assume the existing level of technology.

Brownlee has pointed out the importance of linear programming and the contribution of this technique to decision-making in agricultural production problems. The problem of choosing among alternative enterprises and alternative ways of organizing and managing particular enterprises becomes increasingly critical as the result of changing technology and changing patterns of consumption. Farmers and ranchers face complex problems in deciding on the combination of technology to use with the available land and labor resources.

Brownlee points out the importance of agricultural economists working with researchers in the physical and biological sciences so that research projects may be designed to yield data suitable for economic analysis. This point deserves emphasis. I am happy to report that, in my personal experience, our colleagues in the other fields of agricultural research are ready for such joint effort and, indeed, are asking for help. In several instances, they have asked for more assistance than the agricultural economists have been able to give them. We should not miss any opportunity in this area because the design of many research projects in the physical and biological sciences can have a major effect on the contribution the social sciences will make in helping farmers and ranchers adjust to changing technology.

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Now, let us turn our attention to the factors from outside the agricultural production unit which affect farm or management. Brozen discussed means for maintaining economic stability but limited his paper to the policies and actions of the Federal Reserve Board. Brownlee also discussed certain macroeconomic relationships including international trade. Although there will be disagreement regarding Brozen's appraisal of the effectiveness of the Federal Reserve Board policies in maintaining economic stability, I am sure we would all agree that a high level of employment (or a low level of unemployment) are important to agriculture and that general economic stability will simplify the decision-making process by the farmer or rancher. Stability of the general economy becomes more important to the individual farm operator as he becomes less self-sufficient in both the business and household aspects of farming and more of a purchaser of the inputs for production. Low prices for agricultural commodities have occurred periodically for many years, but the "cost-price"

squeeze" is more typical of present day agriculture.

I want to discuss briefly one other point not mentioned by either Brownlee or Brozen but which I consider of great importance with respect to the contribution the social sciences can make to change and adjustment. An important phase of this problem is to get the prescriptions for adjustment accepted by the patients. I have been impressed recently by suggestions from animal and plant scientists on our agricultural extension staff that they need help from rural sociologists and social psychologists. These are the same staff members who would have said two or three years ago that they didn't know what was involved in either rural sociology or social psychology. The scientific nature of the new findings being passed on to agricultural producers and the rather drastic adjustments necessary to fit the new technology, combine to make the educational process increasingly difficult. This should be a challenge to all social scientists.

# DISCUSSION: IMPLICATIONS TO AGRICULTURAL MARKETING

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My assignment, as I interpret it, is to comment on the contributions of social science, specifically the contributions of the science of economics, as it relates to agricultural marketing. As a basis for my discussion I have had an opportunity to study the two excellent papers by Brownlee and Brozen.

I find I am in accord, with each of these papers. Therefore my criticisms will be largely those relating to omissions or to differences of opinion regarding emphasis. I feel a little like the Navajo Indian, busy sending a series of smoke signals, who observed an atomic cloud arising from Yucca Flats and commented, "I wish I had said that."

Brownlee dates his discussion of "recent" developments in economic theory from Keynes' General Theory of Employment, Interest, and Money, published in 1936. Other dates could have been chosen. For example, a major part of the theory of imperfect competition, so important to problems in marketing, might date somewhat earlier. About the same time, major contributions were being made in demand theory, and the depression drew attention to work relative to business cycles. I believe that, from the standpoint of agricultural marketing, a date in the late 1920's or early 1930's would be more appropriate than 1936.

Proceeding to specific theoretical developments, Brownlee first considers the recent progress in mathematical programming. Although I would not minimize the usefulness of this procedure in the solution of economic problems, I would be inclined to classify programming, as described, as a "tool" rather than as a theory in itself.

The procedure has important implications for marketing research. Some applications have been made relative to interregional competition for specific products. The location of processing facilities in relation to certain production areas can be studied in a linear programming framework. Transportation models are another area in which a programming approach may be useful. Agricultural processing operations, although essentially a form of production, fall generally within the province of marketing research. Here, the transition from programming agricultural production to programming processing operations is very simple.

Programming may also be applied to such areas as a product promotion. Perhaps one of the principal limiting factors in the application of linear programming to many marketing problems, is the lack of adequate basic data. In many aspects of marketing, quantitative input-output data are lacking, and of the change results in marketing systems many do not lend ti
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A second area of theory which Brownlee discusses is that of theories of choice among uncertain prospects. Virtually every decision in the marketing process involves certain elements of true uncertainty. Purchases and sales, times and quantities, inventory management, plant expansion or modification, pricing policies, promotion programs, product development, and many other marketing decisions, are all complicated by the presence of uncertainty. Expenditures for market research are made in the hope of throwing some light on these uncertainties. The theory of uncertainties involves many socioeconomic considerations. Behavior patterns are important and much basic research will be necessary before the theories of uncertainty can be well-defined.

The application of welfare economic concepts to marketing leads to consideration of market regulation and market control problems. At best, many of the assumptions of Pareto optimality are unrealistic in view of apparent internal and external economics of scale, and indivisibility of inputs and products. A well-defined theory of welfare economics would have much to offer in guiding policy decisions relative to market manipulation and control.

The dynamic nature of our economic adjustments and the lags inherent in the realization of changes in variables, makes necessary a consideration of the timing of economic change in the movement of systems toward equilibrium. The imperfect nature of competition forces marketing agencies to take account of compensating changes resulting from actions by their competitors. Long-run demand and supply decisions must allow for technological progress and changes in consumption patterns.

The whole area of international trade has assumed new perspective in recent years in light of the changing position of the United States in the world situation. Market development programs must be geared with attention to trade conditions between nations. Our surplus disposal operations and negotiated trade agreements have important implications for marketing decisions both at home and abroad.

My principal criticisms of Brownlee's paper lie in his omission of, or lack of emphasis on, certain developments in theory which are of particular importance to marketing. Specifically, I would have given more attention to developments in the theory of imperfect competition, to demand theory, and to measures of economic efficiency. Our marketing agencies operate in an imperfectly competitive structure to a much greater extent than is true of farm and ranch units. The nature of imperfect competition and the results of actions by firms operating within the framework of imperfectly competitive markets have far-reaching consequences on the efficiency of our market. Efficiency is as important a goal in marketing as it is in production, and yet the application of economic theory to the

measurement of efficiency in marketing presents many complications for which satisfactory answers are not available. The definition, measurement, and behavior of consumer demand has progressed a long ways from our original concept of utility. Yet, the actions of consumers, given a complex of prices and products, demands a body of theory more complete than that presently available.

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Brozen ties economic stability directly to the level of employment. He then proceeds to discuss the influence of the money supply and real wages relative to the productivity of labor as these variables influence the level of employment. The association between employment, wages, and the level of business activity is apparent. The effect of changes in the money supply upon these variables also seems logical. However, these factors appear to me to be most important in their short-run effects on economic stability. In the long run, I believe that the rate and types of capital formation and the decisions made relative to the allocation of our natural resources may be even more important as determinants of economic stability than is the level of employment.

Major emphasis in this paper is placed on a stable rate of growth in the money supply—2 to 3 per cent per year. The rate selected is approximately the same as the rate of growth of the average productivity of labor since the end of World War II. It would seem that if the keeping of real wages and labor productivity in balance is important, as Brozen has indicated, changes in the growth of the money supply should be tied to changes in labor productivity, which are in turn related to the rate and type of capital formation. Because of the interrelations between all of these economic variables the problem of lags in the system is most important. Although I appreciate the important influence money supply has on stability, and recognize the mistakes made in the past, it would seem that we would be acknowledging the failure of economic theory as a guide for making adjustments if we accepted a constant growth rate of money as being the best plan we could devise.

The maintenance of economic stability has many important implications for marketing. Such stability as may be attained reduces the uncertainties discussed by Brownlee. The major results lie in increased efficiency in planning. Product development, plant development, pricing policies, and other developments within and between firms may be undertaken with greater certainty as to their outcome. Costs and margins may be estimated with greater accuracy, and costs conditioned by economic instability may be reduced. Marketing margins possibly might be reduced. Consumer demand could be estimated more closely. The general efficiency of our marketing process would be increased and benefits should accrue to producers, marketing agencies, and consumers.

#### RESPONSE OF PRODUCTION TO PRICES

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# THE RESPONSE OF WHEAT PRODUCTION TO PRICES WITH EMPHASIS ON TECHNOLOGICAL CHANGE

JOHN A. SCHNITTKER®
Council of Economic Advisers

In THIS PAPER I discuss briefly (a) the concept of a response function as distinguished from a classical supply function, (b) some scanty evidence on short-run changes which might be expected in wheat acreage in response to certain changes in the wheat price only, and (c) factors which must be considered in estimating the actual response of wheat production to changes in the prices of wheat and other commodities, and (d) other factors which may change as these prices change.

Wheat is a most troublesome commodity in Canada and in the United States. The response of output to price is also a troublesome subject. The report of a backward-sloping supply function for wheat in Saskatchewan Province, 1914-39,¹ and another explanation of the situation² are cases in point.

The profession is not blessed with many firm conclusions in supply analysis. The question of whether there is less agreement in the field of individual commodities than in respect to aggregate agricultural output appears to be unanswered at this time. For wheat, however, progress in clarifying the response of production to price changes is far short of the stage necessary to serve as an effective instrument for policy formulation. There is a firm consensus, internationally held, that in the two major exporting countries the response to lower prices is extremely sluggish, negligible in very short periods, and questionable in long periods.<sup>3</sup> The burden of proof is heaviest on those who disagree with this thesis, but it rests on all of us.

It would indeed be comforting if such evidence were produced. But the wheat economy is not a wishing well. We must appraise it as it is. As we do so, we should be required to spell out the total effects of trying to

The judgments expressed here are those of the author.

G. R. Allen, "Wheat Farmers and Falling Prices," Farm Economist, 1954, Volume

VII, pp. 335-341.

<sup>2</sup>Helen C. Farnsworth, and William O. Jones, "Response of Wheat Growers to Price Changes: Appropriate or Perverse?" The Economic Journal, June, 1956, pp.

<sup>&</sup>lt;sup>1</sup>See, for example, The International Wheat Council, *The World Wheat Situation*, London, 1954, p. 28.

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reduce wheat output largely by price means before we argue that the method be tried. The current distance between output and disappearance is sufficient to generate the fear that we may be asking the price system for more than it is cut out to perform.

Readers who have not recently scanned the literature on agricultural supply response are referred to articles by Glenn Johnson<sup>4</sup> and Marc Nerlove,5 and to papers by Fox and Working6 at last year's hearings of the Joint Economic Committee of Congress.

I do not know the ideal method of studying the response of wheat production to price. But I would like to make it clear, with apologies to my colleagues who keep trying, that I consider statistical treatment of the time series of selected indicators of price and output a most unrewarding method. The reasons lie in the definition of a supply curve; a schedule of quantities which would be supplied (or some indicator of these quantities) at all possible prices, other factors held constant,

These assumptions are most unrealistic. I do not argue that we should abandon the concept of a supply function, or that we should not strive for classical supply elasticity estimates. Both are useful as benchmarks for analysis of realistic supply relationships. But the price-quantity data from which supply elasticity estimates have often been made are generated under conditions in which the assumptions are literally "running wild." It is not appropriate to compute a rigorously defined supply elasticity estimate from such data. Rather, such data define what Cochrane called the response function in his paper of three years ago, ". . . it is concerned with the output response to a price change by whatever means that response takes place. . . . The response relation describes what will happen to the quantity of a commodity offered for sale when we do not hold all other things constant. In a sense it is a study of the shifters of supply."7

Economists are called upon from time to time to stop predicting what is going to happen. This is no doubt a safe procedure, but often an un-

Glenn L. Johnson, "Supply Function-Some Facts and Notions," Agricultural Adjustment Problems in a Growing Economy, edited by Earl O. Heady et al., Ames: Iowa State College Press, 1958, pp. 5-8.

<sup>&</sup>lt;sup>5</sup> Marc Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural

Commodities," Journal of Farm Economics, May, 1956, pp. 497-509.

<sup>6</sup> Karl A. Fox, "Effects of Farm Product Prices on Production and Commercial Sales"; E. J. Working, "How Effective Are Prices and Incomes in Bringing about Adjustments Within Agriculture"; *Policy for Commercial Agriculture*, Joint Economic Committee, 85th Congress, 1st Session, November 22, 1957, pp. 405-429 and 430-436, respectively.

Willard W. Cochrane, "Conceptualizing the Supply Relation in Agriculture," Journal of Farm Economics, December, 1955, pp. 1161-76. Cochrane concludes in a later paper that technological advance is the only real shifter of the supply function; see Earl O. Heady, editor, op. cit. p. 97.

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productive one. Much of our work, and especially that in supply response today, is oriented directly at policy formulation. Someone else is going to predict implicitly what the relationships are, and will be, without examining them explicitly unless qualified economists make such predictions. To do so, we must look at "what is" and "what will be," and spend a good deal less time on "what might have been" had all nonprice factors been constant. These factors will be no more stable in the future than in the past.

It would represent progress if we were to use the terms "supply function" and "supply elasticity" for short-run analysis only, because in such a planning period the assumptions are realistic. Thus we may ask the question: What would happen to wheat production by 1961 if we were now to drop all support prices on wheat and let the market be cleared for the next two years, while holding price supports and prices on other products at present levels? If no great technological or other changes occurred by 1961, we may derive a good estimate of wheat acreage for 1961 from an accurate short-run supply elasticity estimate which might be expressed as:

(1) 
$$q_w = ap_w^b$$

If, however, in the short run, we wish also to drop support prices on all grains, or for other reasons we visualize a change in relative prices, or if different rates of technological change occur in wheat and competing crops, we need an estimate of:

(2) 
$$q_w = a'p_w^{b'}$$

where a' is the supply shifter, larger or smaller than a in equation (1) as the prices of alterative products are lower or higher than visualized in equation (1), and as differential rates of technological change occur in farm products. The b' is an elasticity coefficient which takes account of present or prospective, rather than obsolete conditions of production. Neither equation (1) nor (2) can be estimated from time series because the conditions visualized did not exist as time data were generated.

Having reserved "supply" for the short-run planning period, we would follow Cochrane in using the "response function" for the long-run situation in which many factors are, in fact fluctuating, not only in response to price, but to all sorts of external conditions. Predictions about the long-run output of a given commodity at various prices would then be largely predictions of the course of future events in technology, and in price relationships among competing products. Thus, we ask the question: What would the acreage of wheat by in 1970 if a price of \$2.00 a bushel (or any other price) were guaranteed until 1970, and plantings were not limited? The answer is to be found in the benchmark, the

acreage which would now be planted at \$2.00 a bushel, and in the shifters, chiefly technological change and relative prices, matters in which history is a poor guide and the time series obsolete, where judgment replaces statistics. Before going to this dimly-lit area, however, some observations on short-run response are in order.

#### The Short-Run Supply of Wheat

The Hard Red Winter wheat region of the United States presents a difficult and well-known problem in resource utilization. I know of no way to estimate a short-run supply function for this area other than to synthesize it from conditions of production, some of which are discussed below. My hypothesis, also widely held as a conclusion, is that the elasticity of short-run supply for wheat in the subhumid and semiarid plains is very low both in response to higher prices (if we hold cropland constant for a moment), and to lower prices. This arises out of the facts (1) that in periods when acreage controls are not in effect almost all cropland (allowing for fallow) has been in wheat, and (2) the production function is characterized by an extremely narrow input range. With moisture severely limited, a certain minimum amount and timing of cultivation is crucial to produce any wheat at all, but once that ritual has been performed, there is almost no further opportunity to apply further inputs in response to higher prices; hence there is almost no opportunity to expand output along a supply function, nor is there opportunity to contract output even a little by reducing inputs.

In much of this area, about the only way to increase wheat acreage, to increase the quantity of land devoted to crops. This is one of the supply shifters, but it fits also into short-run analysis, tending to make output more responsive to upward price movements, but perhaps less responsive to lower prices in the short run, because of the increased proportion of one-product firms, resulting from the nature of the area. Roughly 10 million acres of grassland was turned into wheat land between 1940 and 1950 in this dry zone. One of the oversimplifications connected with the great shift to wheat production on the arid fringe of the plains is that it was largely the result of high prices and the assurance of their continuation. Certainly price was a factor but not nearly so important as the climatic conditions which prevailed in the years between 1940 and 1950. Hardly a rainfall-reporting station can be located in the area from Texas to Montana which did not have a string of years with precipitation far above average, and large net surpluses for the 10 years.8 The availability of machinery in the postwar years was also an important factor.

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<sup>&</sup>lt;sup>8</sup> Climatic Summary of the United States, Supplement for 1931-52 (various plains states), U.S. Department of Commerce, Government Printing Office, 1956.

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To ascribe the increased output to prices, as though it were the only or even the major factor, or to expect that the movement will be reversed in response to price movements in the other direction is too simple either as an explanation of the past or as an indication of the future. Once land is plowed in the plains, reversion to the previous use is a long, costly process.<sup>9</sup>

Finally, the substitution ratio between wheat and major alternative crops  $(Y_s/Y_w)^{10}$  is such that large changes would have to occur in price ratios and/or substitution ratios to make the alternative crop attractive from an income standpoint. In a small sample survey of about 60 producers in the specialized wheat area of western Kansas and northwestern Oklahoma, one of the questions asked was:

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Of the producers who replied to this question, only 10 per cent gave affirmative answers to (a). Forty-three per cent indicated that at a price of 60 per cent of parity for wheat they would plant considerably more grain sorghum. Sixty per cent would move in that direction if the wheat price were at (c), 50 per cent of parity. Grain sorghum prices have been at or below 70 per cent of parity in recent years. Thus the 50-60 per cent of parity wheat price required to get much of an acreage shift appears consistent with data presented later indicating an income disadvantage of roughly one-fourth to one-third for grain sorghum under recent actual price ratios.

A study by Winklemann indicates comparable results in Nebraska based on 1955 conditions. Peplies of producers in four economic areas from west to east in southern Nebraska indicated definite price responsiveness only in the eastern area where wheat occupies little of the cropland. However, in not one of the areas was it indicated that a price of \$1.40 per bushel (more than 30 per cent under the 1955 price), other factors constant, would result in a smaller acreage than was planted

<sup>&</sup>quot;Assume that the yield and price of your best alternative crop remains about as in the past 5-10 years. Would you plant considerably more (best alternative crop) than at present if wheat prices fell to:

a. 70 per cent of parity or about \$1.70 bu.?

b. 60 per cent of parity or about \$1.45 bu.?

c. 50 per cent of parity or about \$1.20 bu.?"

<sup>&</sup>lt;sup>9</sup>H. G. Sitler, Returning Cropland to Grass in East-Central Colorado, Agricultural Research Service, USDA (Mimeographed), 1955.

<sup>&</sup>lt;sup>30</sup> Y<sub>\*</sub> represents the yield from an acre of an alternative crop, Y<sub>\*\*</sub> the yield from an acre of wheat.

<sup>&</sup>quot;Most of the producers questioned also expected grain sorghum prices to fall with wheat prices, creating a condition in which little or no acreage adjustment would be indicated.

<sup>&</sup>lt;sup>13</sup> Donald L. Winklemann, Some Factors Affecting the Wheat Supply in Nebraska, unpublished M.S. Thesis, University of Nebraska, 1957.

under acreage restriction in 1955. At a wheat price of \$1.20 per bushel, other prices as in 1955, a 5 per cent reduction from 1955 acreage was indicated on the sample farms in the four areas combined.

A further indication of the difficulty of reducing wheat acreage in response to price in the semiarid plains is found in recent relationships between the yields and prices of wheat and grain sorghum, almost the sole short-run alternative. No county in the western one-third of Kansas has a ratio of average yields, 1945-54, such that if average yields were attained, sorghum would be more profitable than wheat even in the years when the sorghum price is most favorable. In these counties, 1945. 54, the annual average prices received by farmers for grain sorghum and wheat produced a range of price ratios (Pw/Ps) of 1.3 to 1.9. While average sorghum yields were higher than wheat yields in many counties. they were not high enough to offset the wheat price advantage, which produced a ratio of 10-year average prices which was from 1.3 to 1.7 times the yield ratio (Yw/Yw). Similar relationships exist also in more humid areas as shown by data in a recent study, indicating per acre income from grain sorghum in central Kansas to be about 68 per cent of income from wheat, based on 1955 prices.13

Other things being equal, declines in the wheat price of roughly 25-40 per cent should set up conditions of profit maximization through a shift from wheat to grain sorghum. However, consider one more factor, that of uncertainty. In choosing to specialize in one crop or another, producers consider not only yields of alternative crops, but the certainty with which these yields may be expected. As in the case of prices, we may assume that a producer considers certainty of yield as a partial substitute for level of yield. He may, therefore, discount the yield expectations of production alternatives to which the greater uncertainty is attached. Similarly the prices of alternative crops may be expected with different degrees of certainty and appropriate adjustment made in the price ratio for this fact.

Three fragments of evidence suggest that in western Kansas and Oklahoma, and probably in contiguous areas, price and yield expectations are such that grain sorghum production is discounted, further increasing the wheat price change required along a supply curve to achieve substantial shifts to grain sorghum. First, in only two counties of 54 in the western half of Kansas is the ratio of the standard deviation to the mean of the available series of annual yields of wheat greater than for grain sorghum. In most counties, this ratio is sharply lower for wheat. Second, of producers questioned in the study noted earlier, 75 per cent said that they

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<sup>&</sup>lt;sup>13</sup> C. W. Nauheim, W. R. Bailey, and D. E. Merrick, Wheat Production, Agricultural Research Service, USDA, Agr. Inf. Bul. 179, 1958, p. 68.

consider their best alternative crop, chiefly grain sorghum, to be less certain than wheat from a yield standpoint. Third, the same producers consider the grain sorghum price situation a considerable discount factor, 80 per cent indicating they thought that price more uncertain than the

wheat price.

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These indicators are certainly tentative. Yet they add to the evidence that in a highly specialized area of the Great Plains, producing 60-70 per cent of the Hard Red Winter wheat, and 25 to 30 per cent of all wheat in most years, significant changes in wheat acreage and/or production along a short-run supply curve are quite unlikely. It is possible, however, that some of our wheat surplus problems may soon shift to feed grains. Commercial hybrid sorghum production is only two or three years old, but already it looks promising. In dryland yield tests at Kansas State College in 1957, hybrids ran from 10 to 50 per cent above other grain sorghums at various locations. 4 Bonnen, 5 in appraising the technological improvement prospects for wheat and grain sorghum by 1965, gave sorghum a wide margin over wheat. In my judgment, the total gain will have to be of 25-40 per cent to overcome the present disadvantage in yields and prices. But if the relative price position of sorghum improved a little also as wheat moved toward a feed grain price level, a yield improvement of 10-20 per cent in grain sorghum would initiate a reduction in wheat output in this area.

Certain parallels exist in much of the Hard Red Spring wheat area. Rainfall is an important limitation; hence the cultivation problems and the production function are similar. Output cannot be increased much on a given acreage either through cultivation or through the use of fertilizer. I do not have yield data for the major alternative crops in this area comparable to the data given for Kansas and the southern plains. My best guess is that in the most arid part of this area, largely in Montana, the conditions which would induce a considerable change in the crop balance are about like those required in the southern plains. In the recent USDA study, net income per acre of barley, North Central Montana, was placed at 48 per cent of income from wheat, with 1955 prices. 16

The northwest wheat area also exhibits certain characteristics which yield an inelastic supply function in the Great Plains. While moisture is limiting in much of the area, the range of inputs, especially fertilizer, is certainly greater. Whether or not the alternative crops are as unfavorable here as in the southern plains is a matter yet to be examined. Net income

paper, Kansas State College, Department of Agronomy, January 1958.

Bames T. Bonnen, "American Agriculture in 1965," Policy for Commercial Agriculture, op. cit., p. 149.

"Nauheim, et al., op. cit., p. 68.

<sup>&</sup>lt;sup>a</sup> A. J. Cassady, "New Prospects in Sorghum Hybrids for Kansas," Mimeographed Peper, Kansas State College, Department of Agronomy, January 1958.

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per acre from barley and peas in the Washington Palouse area has been estimated, respectively, at 36 per cent and 59 per cent of net income from wheat.<sup>17</sup>

The final area considered is known historically as the Soft Red Winter area. However, Hard Red Winter now predominates in Missouri and Illinois, and Michigan has shifted sharply to White wheat in the last 20 years.

Again, we have little to go on in this area. Winklemann<sup>18</sup> reported for southeastern Nebraska an estimate of supply elasticity of 1.15 in the range of \$2.00-\$1.20 per bushel for wheat. Bowlen,<sup>19</sup> however, proposed 0.32 for eastern Kansas. Some number between these two estimates may be appropriate for areas similar to those parts of Nebraska and Kansas where about one-fifth of the cropland is in wheat.

Further east, information was obtained from a sample of Ohio producers in 1956 on fertilizer practices under widely different alternative prices for wheat, \$2.50 and \$1.25 per bushel.<sup>20</sup> Only 22 per cent of producers questioned indicated they would increase their fertilizer application if the wheat price rose to \$2.50 from an expected \$1.80. Only 12 per cent indicated they would decrease their fertilizer application if the price fell to \$1.20 from an expected \$1.80.

In response to a question on changes in acreage seeded to wheat in response to the changes in the price expectation given above, 71 per cent of the Ohio producers indicated they would plant the same acreage of wheat at all three prices. Twenty-two per cent would decrease acreage in response to price decreases and 13 per cent would increase acreage in response to price increases.

These data do not offer much support to the notion that moderate changes in price, say downward to somewhere around the present world price, or around 60 per cent of parity as calculated today, would induce a shift from wheat which would make much of a difference in our supply-demand balance. In my opinion, the indicated response is about what should be expected for several reasons.

First, wheat in much of this area is grown largely because of complementary or supplementary relationships with other crops. These include providing bedding for livestock, cover crops for legumes, income in

<sup>17</sup> Ibid., p. 68.

<sup>&</sup>lt;sup>18</sup> *Ibid.*, p. 41.

<sup>19</sup> B. J. Bowlen, "The Wheat Supply Function," Journal of Farm Economics,

December, 1955, p. 1185.

<sup>20</sup> M. G. Smith, F. B. McCormick and R. J. McCoy, An Analysis of Ohio Wheat Growers' Views and Responses in 1956 to Federal Agricultural Policies, Ohio State University, Department of Agricultural Economics and Rural Sociology Mimeographed Bulletin A.E. 270, 1956, p. 9.

a season when other crops require cash outlays, and spread of the workload. Also, wheat is an extremely favorable crop to produce in combination with nontarm employment. I am told by a knowledgeable Michigan man that many of their wheat producers would stay in business at very low prices, because wheat fits so well with off-farm work.

Certainly it is too early for conclusions, so again I propose a hypothesis. The short-run wheat supply function in the humid area producing White, Soft Red Winter and Hard Red Winter wheat is quite inelastic, but not so inelastic as in the other major producing areas. Whether it is near the .1 to .2 suggested (not estimated) for all wheat by Cochrane<sup>21</sup> or not, in my judgment it is well below the .93 estimated by Nerlove.<sup>22</sup> Whatever it is, for Soft Red Winter or all wheat, I doubt if it makes much difference, because significant adjustments, if such are made, will be in response to many factors, and are not likely to be made chiefly in response to reductions in the price of wheat.

## Long-Run Supply Reponse

In the concept of supply response we consider the actions of producers, as prices and many other factors change over a long series of years. This is the realistic area in which to discuss adjustment of wheat production to levels which can be consumed and exported, say 10 years from now. There are three major questions considered here, all in terms only of response to lower wheat prices, since higher wheat prices do not appear to be of much pertinence today in the United States or in Canada.

1. What kind of technological response would lower prices generate? What shifts might occur in the short-run supply functions through which, with a fairly constant demand, the response path would be drawn? Would lower prices and expected lower incomes stop or seriously impede adoption of cost-reducing innovations?

2. Closely related to this matter is the question of changes which would occur in farm size in specialized wheat producing areas. If technological changes, cost-reducing by definition, were also largely capitalusing, a considerable long-run shift in size of farm could be generated by lower prices. Lower prices might influence who produced the wheat to a greater extent than they would affect the amount produced.

3. Finally, it is largely academic to discuss price changes for wheat without discussing also the effect on prices of substitute crops. If the price for corn and other feed grains is responsive to the actual or potential influx of wheat into feed uses, the prospective change in relative prices between wheat and feed grains is small.

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<sup>&</sup>lt;sup>11</sup> Op. cit., p. 1164.

<sup>&</sup>lt;sup>2</sup> Op. cit., p. 505.

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The first two questions, the nature of technological change during the period of reduced prices and the extent of farm consolidation, are closely related. History does not support the view that there are technological innovations waiting to be adopted in wheat production which would lower costs considerably without requiring a great deal more capital in some form. Opinions vary on the speed with which wheat yields are increasing. Bonnen<sup>23</sup> suggests 2 per cent annually for the next 10 years, but higher "guesses" are also current. Unless the output of new, yield-increasing varieties, adoptable at low cost, is increasing rapidly, most of the increase must be due to other elements, such as increased use of fertilizer and improved tillage.

I recently asked agronomists engaged in wheat research in the 22 leading wheat states for estimates of the output contribution of new varieties adopted in their states, 1924-54. To my surprise, the result was that new varieties alone, when weighted by the acreages planted to the various varieties in each period, other factors constant, increased 1954 wheat production by about 12 per cent over 1924. The same agronomists estimated that tillage improvements in the same period, chiefly the perfecting of fallow methods and better timing of operations, resulted in 1954 output which was 19 per cent above that expected under 1924 conditions. The two together added about 30 per cent to output, according to these agronomists. While there is some evidence of concentration of new, yield-increasing varieties in the last 10 years as crop-breeding efforts have matured, there was a fairly steady flow of new varieties in earlier years. I seriously doubt that varietal improvement will be a source of considerable yield increase in the next 10 years.

Rather, I propose the thesis that the major cost reducers and output increasers in wheat in the period just ahead are capital-using technologies, and that low prices in the 1960's would not seriously impede adoption of the technologies. Lower wheat prices and assurance that they would continue for a long period would eventually encourage out-migration of producers who could not adopt the technology required to produce at a cost below the expected price. If capital were available to remaining producers, either as credit or as existing excess capacity, farm consolidation and realization of scale economies inherent in technologies now known but held back by the nature of farm organization and other institutional factors, would be accelerated.

Ignore, for now, the question of the desirability of these farm consolidations. The important question here is the output response of farm firms in major areas, especially the area producing Hard Red Winter and Hard Red Spring wheat. If output increases and cost reductions achieved, say

<sup>23</sup> Op. cit., p. 149.

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in 10-15 years, through consolidation and increased mechanization, were very minor, so that the successive supply functions were only slightly to the right of the benchmark supply function, output might be reduced slightly in response to a given price decrease over time. If, however, as I suspect, there are large economies to be realized through farm consolidation and the adoption of large-scale equipment not only in the specialized areas, but also in wide fringe areas where farms are historically small, the short-run supply function would shift a considerable distance. Costs per acre or per bushel having been reduced, producers would then produce as much or more than at present even though prices were reduced sharply. These possibilities were pointed out for the Corn Belt in a paper last year by Heady,<sup>24</sup> and are at least as important in much of the wheat area. The big question mark is the speed with which the changes might occur.

But we have not considered the third and perhaps the most important point, the possibility that the change in relative prices of wheat and alternative crops would be small or nonexistent, because the prices of other crops would fall also. There are good indications that the price of wheat can fall somewhat from recent levels without affecting the prices of feed grains. But this cannot go on indefinitely, especially with the present supply conditions in feed grain. Foote<sup>25</sup> once estimated that a l per cent addition to the supply of feed concentrates would result in about a 2.5 per cent decline in the price of corn. At present each 100 million bushels of wheat fed or available for feeding annually adds about 2 per cent to the supply of feed concentrates. If only 100 million bushels of wheat were available each year, the effect on the price of corn would be minor. If, however, as appears to be the prospect, large stocks and large current supplies were available at such prices, it is difficult to see how the effect on feed grain prices could fail to be much greater. This would tend to remove the incentive to shift away from wheat, even in the areas where the shift is most feasible.

Finally, I do not wish to leave the impression that I judge the wheat supply totally unresponsive to downward price movements. But we have neither historic experience nor present evidence to confirm the notion that wheat producers would, in the short run, reduce plantings significantly in response to relative price reductions of the nature of one-third from the present, nor do we have much reason to hope that a little longer run will rescue us.

<sup>&</sup>quot;Earl O. Heady, "Progress in Adjusting Agriculture to Economic Change," Journal of Farm Economics, December, 1957, p. 1344.

<sup>&</sup>lt;sup>3</sup> R. J. Foote, Statistical Analyses Relating to the Feed-Livestock Economy, USDA Technical Bulletin 1070, 1954, p. 8.

# DISCUSSION: THE RESPONSE OF WHEAT PRODUCTION TO PRICE WITH EMPHASIS ON TECHNOLOGICAL CHANGE

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J. C. GILSON University of Manitoba

As Schnittker suggests, there is an uncomfortably wide divergence of opinion on the nature of the response of wheat production to price. Agricultural economists have repeatedly attempted, without too much success, to reconcile the classical theory of the firm with the empirical investigation of the wheat supply function. Thus far it would seem that we have not had a major "breakthrough" in this area of research. Does this mean that we have to admit to an empty economic box? Not quite. A peek into the box reveals a controversial assortment of statistical wheat supply functions.

In spite of persistent frustrations, I agree with Schnittker that we cannot afford to abandon work on the wheat supply function—the need is far too important. Furthermore, if economists fail to lead the way, farm organizations and politicians will implicitly predict the wheat supply function for policy purposes. Some farm leaders with whom I have discussed this matter, have suggested for example, that if wheat prices continue to fall, farmers will repeat their reaction of the 1930's—they will produce more wheat than ever. It is not difficult to see the implications of this conclusion.

Schnittker hits a vulnerable spot when he states that the assumptions for supply analysis are "running wild." The ceterius paribus clause has severely restricted our movement into the world of reality. Technology, prices of competitive crops, weather and other relevant factors do not remain constant. The conventional assumptions of supply analysis have been useful simplifying devices but they have seriously hampered meaningful, empirical investigation.

Schnittker proposes that the method of avoiding the difficulty of the ceterius paribus clause would be to divide the research into two broad areas: (1) the short-run planning period concerned with the "supply function;" (2) the long-run situation concerned with the "response function." In the case of the supply function Schnittker suggests that the conventional assumptions make sense. In the second case Schnittker would apparently abandon the ceterius paribus clause of the classical theoretical model. He would permit all the relevant factors to vary within his wheat response equation.

I agree with the distinction made. Agricultural economists can make a worthwhile contribution towards the derivation of empirical estimates for the short-run wheat supply function. On the other hand, I wonder how

far we can go in deriving reliable empirical estimates for Schnittker's wheat response function of 1970? Technological changes in the next two decades will probably be running wild. I would doubt whether it is worthwhile to spend too much time in working on refinements of a long-run wheat response function. Far better if agricultural economists were to use their resources in keeping the short-run wheat supply function up to date.

I do not propose to examine Schnittker's treatment of the response of wheat production to price in the various regions of the United States. However, I would like to examine the likely nature of the wheat supply function in western Canada and the implications of technology in wheat production.

Insofar as the wheat supply function in western Canada is concerned, the Allen v. Farnsworth controversy is a good example. Allen derived a backward sloping supply function for wheat in Saskatchewan. Farnsworth, using essentially the same series of acreage and price data, derived a positively sloping supply function. This illustrates the uncomfortable position in which we find ouselves in supply function analysis. I am not prepared to adjudicate at this time on the Allen versus Farnsworth controversy. It would seem that many other variables in the equation, besides price and acreage, need to be considered before final judgment is passed.

I would like to note some of the considerations needed in any meaningful investigation of the wheat supply function in western Canada. The following general equation will make explicit some of the factors that influence the response of wheat production to price.

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Aw is the wheat acreage

 $X_1$  price of wheat in some period prior to the planting of wheat

X<sub>2</sub> light brown, dark brown, black earth and grey-wooded soil zones

 $X_3$  crop alternatives to wheat

X<sub>4</sub> crop rotation requirements
 X<sub>5</sub> income of farmers in some prior year

X<sub>6</sub> price of crops competitive to wheat

X<sub>7</sub> government policy, e.g. marketing quotas

X<sub>8</sub> price and yield expectations

 $X_9$  technology; e.g. herbicides, pesticides, fertilizer, rust-resistant grain

 $X_{10}$  ratio of fixed to variable operating costs  $X_{11}$  ratio of summerfallow to wheat acreage

Many of the empirical investigations have failed to yield meaningful results because many of the variables of the above equation have been ignored. Allen's supply function was essentially of the following form:

$$Aw = f(X_1)$$

Farnsworth expanded the equation,

$$Aw = f(X_1, X_3, X_6)$$

The tremendous scatter of the data around Allen's and Farnsworth's supply functions may be explained by the neglect of other relevant factors. For example, periodic outbreaks of a new strain of rust have caused producers to discount severely the profitability of wheat until plant scientists come to the rescue with a new, rust-resistant variety of wheat. Then too, crop alternatives to wheat vary from one soil and climatic zone to another. A rise in the price of flax relative to wheat will cause producers in one area to shift out of wheat while in another area the wheat supply function is relatively inelastic.

It is obvious that the "real" wheat supply function must involve a great number of variables. If we are to carry on meaningful research on the wheat supply function, we must be prepared to go beyond a mere deflation of a series of wheat prices. The laboratory for the supply function analyst is to be found in the matrix of variable events which form the decision-making environment of the wheat producer.

I will conclude this discussion with one major hypothesis for the future: If wheat producers successfully adopt all of the current and potential production technologies, the wheat supply function will tend to become more elastic. Wheat producers will tend to be more responsive to price changes.

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#### THE RESPONSE OF MILK PRODUCTION TO PRICE\*

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RECENT efforts of dairymen to obtain so-called "self-help" legislation permitting marketing controls illustrates farmers' increasing concern with the persistent increase in milk output and a recognition that higher price goals probably cannot be achieved without some control on supply. At the recent hearings of the Joint Economic Committee on Policy for Commercial Agriculture, the questions having to do with farmers' supply response to price were among those major ones left unanswered. The whole fabric of our past and present price support program cannot be adequately judged without clear-cut answers to many questions about the response of production to price. The points above illustrate and emphasize the need for well-founded conclusions in this area.

The history of price analysis has shown a major preoccupation with demand analysis, and important successes have been achieved in the field of food demand analysis. It is my conviction that the analysis of food demand is among the less difficult areas of demand, but of course, this is not an attempt to discount the impressive analytical and methodological achievements which have been made, for they have been substantial. However, the problems become increasingly difficult once attention is focused on demand for such things as the semidurables. Here the dynamics of demand will be much more of a problem, for among other things, the role of expectations and the nature of the market structures and pricing policies require formulation of much more complex models than in the area of food demand.

In the case of producer response, the role of expectations along with lags in response have posed difficulties for analysis which have not yet been completely overcome, although important strides have recently been made by Nerlove. We have been able to obtain quite satisfactory results in food demand studies with highly aggregative data on the assumtion that consumers react pretty much in the same ways throughout the

<sup>&</sup>lt;sup>o</sup> Computations and analysis in this paper received financial support under NCM-11, subproject 4, Dairy Price and Income Policy.

<sup>&</sup>lt;sup>1</sup>Marc Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural Commodities," *Journal of Farm Economics*, May, 1956, pp. 496-509.

Commodities," Journal of Farm Economics, May, 1956, pp. 496-509.

Marc Nerlove, "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Considerations," Journal of Farm Economics, May, 1958, pp. 301-311.

Marc Nerlove and William Addison, "Statistical Estimation of Long-Run Elasticities of Supply and Demand," manuscript submitted for publication in *Journal of Farm Economics*, 1958.

United States. But this degree of aggregation in the analysis of farmer producer response poses many methodological problems because the alternatives to resource use are highly variable throughout the country, and national data will obscure many of these relationships. Then too, the fact that the farm is both home and place of business may make some patterns of response to economic incentives difficult to explain purely in terms of firm theory. Specification of the time dimensions of analysis also has often been ignored. Or an implicit assumption of an annual planning period often has been made simply because this is the way many data come to us, although there is no certainty this is the relevant period for important problems. Thus, convincing answers to questions of producer response to price are likely to be somewhat harder to come by than answers to similar questions in the field of food demand.

Attempts have been made in recent literature<sup>2</sup> to distinguish between supply elasticity and the elasticity of producers' response wherein the former represented the static situation in which the state of the arts was held constant, while the latter allowed the arts, as well as some other things, to change. The response relationship may thus, to some extent, attribute to price the result of those factors undergoing change which are not included in the model. Thus the output response relationship is essentially an inadequately specified model and, as such, has been termed

a "mongrel" relationship.

In any practical situation, of course, the problem is not the choice of either the former or the latter, because we are inevitably forced to derive response relations in most time series work simply by virtue of the fact that a model including all relevant variables probably could not be solved with the data at hand. The real issue is more nearly whether the model which is used is reasonably adequate. Assuming that we had adequate measures of changes in the state of the arts, I think most of us would prefer to incorporate these in our models, whether they be for predictive purposes or simply to describe better the structural relationships. To say that the response to a price increase ceteris paribus (a supply response) is different than the response to a price increase when costs also increase by some unspecified amount (an output response) and to suggest that the latter model is superior seems unacceptable so long as the supply response estimate is derived from a model which included costs in a logical formulation. But this is quite a different matter than the alleged failure of economists to give adequate consideration to the role of technology in accounting for observed output responses.

The approaches used to derive estimates of the influence of price on

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<sup>&</sup>lt;sup>2</sup> W. W. Cochrane, "Conceptualizing the Supply Relation in Agriculture," *Journal of Farm Economics*, December, 1955, pp. 1161-1176.

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production have been mainly along two routes. These differ more by the type of data used and the statistical techniques applied, and recently, less by important differences in the models used. The methods of fitting models into the highly aggregative time series studies, until recently, have relied mainly on traditional regression techniques. Estimates based on individual firm data, either real or hypothesized, have evolved from analvsis of farm business records through budgeting techniques to the current rage of linear programming. Significant methodological advances along both routes give promise of a much improved understanding of the nature of output responses.

Technological change can be built into linear programming formulations by appropriate changes in the coefficients. Built-in lags in response do not seem to be incorporated yet in any programming models I am familiar with, but they may come later. A serious programming difficulty at present is that of incorporating uncertainty or probability distributions of expectations, but some work is underway in this area. As has been recently shown,3 it is possible to conceptualize an aggregative supply function through combining results of individual programs which are representative of the various kinds of firms (assuming that all resource restrictions, availability situations and input-output coefficients are adequately specified), but the aggregation problem still involves many unanswered questions.

Some recent work in the traditional demand-supply area (which formulates models incorporating expectations and/or lagged response) promises to set a new direction to supply response work. Here, too, there are many difficulties and additional work may qualify the "promising results" of early trials with relatively simple models. In the following discussion of statistical results, I draw upon illustrations of both approaches (mainly by others) to indicate some useful results in understanding producer response in milk production.

Without recounting in detail the previous work on the supply elasticity for milk, one cannot help but be impressed with the amount of research which has been devoted to this subject and the number of published works in which milk has been used to illustrate the major points being made. Among these are the early work of Ezekiel and Cassels,4 followed by the book Interregional Competition in Agriculture<sup>5</sup> in which milk

<sup>&</sup>lt;sup>8</sup> Arvid C. Knudtson and W. W. Cochrane, "A Supply Function for Flax at the

Firm Level," Journal of Farm Economics, February, 1958, pp. 117-23.

'John M. Cassels, "The Nature of Statistical Supply Curves," Journal of Farm

Economics, April, 1933, pp. 378-87. John M. Cassels and Wilfred Malenbaum, "Doubts About Statistical Supply

Analysis," Journal of Farm Economics, May, 1938, pp. 448-61.

R. L. Mighell and J. D. Black, Interregional Competition in Agriculture, with

Special Reference to Dairy Farming in the Lake States and New England, Cambridge: Harvard University Press, 1951, pp. 251-55.

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was the focal point of the study and derivation of supply response estimates played a key role.

Cassels called attention to the family of short-run supply curves which result from lengthening the period of adjustment, to the nonreversibility of the relations, and (in an article with Malenbaum in which correlation methods were studied closely) to the importance of including all the relevant variables in the analysis if meaningful results are to be obtained. These articles still stand as significant contributions to the literature on supply response and the results tend to suggest elasticities for milk of a low magnitude.

The Interregional studies of the late 1930's relied heavily upon the technique of budgeting supplemented with well-informed judgments about the characteristics of the particular areas being studied. Within a framework of certain well-defined assumptions, estimates of probable supply 10 years later were derived for each of these areas. When these were combined for New England and the Lake states, the supply elasticity for this period turned out to be about .35. The complexity and magnitude of the task along with the difficulties of dealing with several unanswered questions have mitigated against extensive use of this method for regular predictive purposes.

More recent efforts using real or realistic hypothetical data for the firm have involved the use of linear programming. Many of the limitations to budgeting apply with equal force here, but programming has many advantages too, not the least of which is precise specification of the model and alternative processes available.

Among the most recent and interesting efforts using this technique are Faris and McPherson's applications to North Carolina dairy farms. Under the conditions specified, it was possible to map the effects of changes in price and cost for certain items to portray the range within which optimum enterprise combinations would not change. They concluded, "The limits within which the price of milk and labor can vary before optimum enterprise combinations change are quite large on the small and medium-size farms. This production stability in the face of considerable factor and price change decreases with an increase in farm size." At least two conclusions are implied by this: first, milk production is price inelastic and, second, it is getting less inelastic if we take account of the trend toward larger sized units.

<sup>&</sup>lt;sup>6</sup> J. E. Faris and W. W. McPherson, "Application of Linear Programming in an Analysis of Economic Changes in Farming," The Review of Economics and Statistics, November, 1957, pp. 421-34.

November, 1957, pp. 421-34.

W. W. McPherson and J. E. Faris, "'Price Mapping' of Optimum Changes in Enterprises," Journal of Farm Economics, November, 1958, pp. 821-834.

From this it is a short step to derive the response relation for the firm, not only for the given product whose price is changing, but also for the other products of the firm whose output is changed. At present, however, we are still a long way from making the transition to an aggregative supply relation—or response relation from this technique. But the impressive growth of programming in the short span of about 10 years, by simple extrapolation, promises much for the future. It is not difficult to visualize the possibility of combining improved programming techniques with other work on simulated models to generate aggregative response results which can be expected under various combinations of market, technological and stochastic processes. The rapid advance in computer speed and capacity should make this a reasonable possibility in the foreseeable future.

At the aggregative level, probably the most recent published result of an attempt to derive a milk supply function based on time series data is that of Cochrane in his Farm Prices—Myth and Reality. Here quarterly estimates of milk production are related to prices (average of current and lagged one quarter), feed costs, cow numbers and production per cow. For the period 1947-56, Cochrane concludes the supply elasticity to be in the neighborhood of .03, but not statistically significant. Considering the short period of adjustment allowed, this low value is not surprising although slightly lower than those derived in some earlier work of mine<sup>8</sup> developed on slightly different lines and using different data.

Recent work by Nerlove<sup>9</sup> using the idea of distributed lags in an expectation model applied to cotton, wheat and corn, and a forthcoming article on vegetables, using a lagged response formulation with "promising results" stimulated me to further work on milk. This procedure of distributing the lag in response enables one to derive estimates of "short-run" and "long-run" elasticities, although the specific time content of the "long-run" elasticity may not be fixed in advance.

Following the Nerlove formulation, farmers' planned long-run output of milk is  $\overline{q}$  assuming other prices are held constant. If farmer output adjustment decisions are based on last year's price and T is a trend factor representing an aggregation of forces influencing planned output, for example, growth of technology, the simplest form of supply equation might be

$$q_t = a + bp_{t-1} + cT \tag{1}$$

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<sup>&</sup>lt;sup>1</sup> W. W. Cochrane, Farm Prices—Myth and Reality, Minneapolis: University of Minnesota Press, 1958, pp. 181-82.

<sup>&</sup>lt;sup>8</sup> Harlow W. Halvorson, "The Supply Elasticity for Milk in the Short Run," Journal of Farm Economics, December, 1955, pp. 1186-97.

See footnote 2.

To bring our price variable into a form which has removed the swings in the general level of prices received by farmers, we deflate by the Index of Prices Received by Farmers. Our equation representing the extent of adjustment of current output,  $q_t$ , from that of a year ago then would be

$$q_{t} - q_{t-1} = \gamma (q_{t} - q_{t-1})$$
 (2)

Where  $\gamma$ , the coefficient of adjustment, represents the extent to which farmers adjust in the direction of planned output the first year. Substitution of (1) in (2) gives our estimating equation (3)

$$q_t = \gamma a + \gamma b P_{t-1} + (1 - \gamma) q_{t-1} + \gamma c T$$
 (3)

When this is fitted, the "long-run" supply elasticity can be estimated from the coefficients of (3), while the "short-run" elasticity is derived from the coefficient of  $P_{t-1}$  (or is given directly by this coefficient if the data are in logarithmic form).

Obviously this supply equation (1) is excessively simple. Many important variables have been neglected. In order to show the effect of stepwise expansion of the model on the elasticity coefficients, additional variables including hay supplies, concentrate supplies, beef prices and hog prices were successively introduced into it and these results are presented below.

In this formulation the difference between the short-run and long-run elasticities is a function of the size of  $\gamma$ , the coefficient of adjustment. The smaller the coefficient, the more elastic the long-run supply relative to that for the short run. Furthermore the absolute size of  $\gamma$  is of some interest since variation in it through time should reflect the changing composite influence of such things as relative price certainty, flexibility of the firm to make adjustments, etc. In addition, logical stepwise expansion of the supply equation will result in modification of our estimates of  $\gamma$ , and a part of this change can be considered as reflecting specification bias or failure to include all relevant variables.

In order to examine some of these elements, data for the two periods 1927-1957 and 1941-1957 were fitted in identical fashion. The results are presented in Tables 1 and 2. The first line of results in each table ignores the issue of long-run adjustment and assumes all adjustment occurs with the given lag of one year. Each of successive models below it takes into account the adjustment toward some planned output over a longer period of time, reflected by the size of the coefficient of adjustment.

Several interesting points may be illustrated by examining these two tables. For the period 1927-57 (Table 1), equation 1.4 based on milk prices, time, milk production the previous year, hay supplies and concentrate supplies gives a satisfactory fit (R<sup>2</sup> of .967), and the coefficients are of logical sign with all but concentrate supplies being at least twice its

TARLE 1. MILK PRODUCTION! ANALYSIS, UNITED STATES: STATISTICAL RESULTS SHOWING EFFECT OF SPECIFIED VARIABLES AS MODEL IS EXPANDED. 1997-573

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	lasticity	Long		.438	.439	.398	.403	.403
	Supply elasticity	Short	.185	.128	.165	.157	.157	.157
	Coefficient	of adjustment		. 292	.376	. 394	. 890	. 390
1927-572		R <sup>2</sup> 1.—	688.	.958	996.	.967	.967	.967
EFFECT OF SPECIFIED VARIABLES AS MODEL IS EXPANDED, 1927-572	1	nog price³						0004
MODEL IS		prices					.001	.001
ARIABLES AS	Supply of	total con- centrates				.017	.016	.016
SPECIFIED V	T. L. J.	supply4			.118 (10.23)	.104	.105	.105
EFFECT OF	Milk	production previous year		.708	.624	.606	.610	.610
	Time		10.051 (202.43)	8.162 (6.58)	2.289 (4.34)	2.172 (3.74)	2.180 (2.92)	2.13 (2.79)
	M:III-	price	.045	.031	.040 (10.39)	.038	.038	.038
		numper	1.1	3.5	1.3	1.4	1.5	1.6

<sup>1</sup> To the nearest hundred million pounds.

<sup>2</sup> Values in parentheses below the regression coefficients are their F values. The degrees of freedom for error mean square declines by one for each successive equation beginning with d.f. = 28 for 1.1 to d.f. = 28 for equation 1.6.

<sup>3</sup> Milk, beef and hog prices are U.S. annual average prices received by farmers deflated by the Index of Prices Received by Farmers, 1947-49=100

for the previous year. Milk prices are to the nearest tenth of a cent and beef and hog prices to the nearest cent.

4 Total hay supply is for the current calendar year beginning May, to the nearest 100,000 tons. The content of this variable is somewhat unsatisfactory in that it does not completely represent the calendar year period of response. It can probably be considered mainly as exogenous and repre-

sentative of summer and fall pasture and roughage supplies.

• Supply of total concentrates, for the year beginning the previous October, to the nearest hundred thousand tons.

TABLE 2. MILK PRODUCTION! ANALYSIS, UNITED STATES: STATISTICAL RESULTS SHOWING EFFECT OF SPECIFIED VARIABLES AS MODEL IS EXPANDED, 1941-572

1			1					
	Supply elasticity	Long		988	.541	. 526	.155	.154
	Supply e	Short	.304	.919	685.	986	.184	.180
	Coefficient	of adjustmen <sub>t</sub>		.859	.534	. 544	1.185	1.166
-10		R <sup>2</sup> 1.—	.625	.876	806.	.910	.947	.948
1401, 1041	1	nog price³						004
EL IS LAFA	1	price3					060 (7.07)	$\frac{-060}{(6.43)}$
TOTAL OF SALES	Supply of	total con-				.021	(3.10)	.058
Dreckled Vaniables as Model is Laranded, 1911-91-	Total Land	supply4			(4.13)	.152	.241 (7.99)	.230 (5.48)
DEEC	Milk	production previous year		.648	.466 (10.43)	.456 (9.26)	185 (.47)	166
		Time	5.417 (17.25)	2.311 (5.49)	1.561 $(2.65)$	1.263 (1.26)	2.870 (6.99)	2.905 (6.42)
	W:III.	price3	.081	.083	(26.55)	.076	(9.53)	.048
	5	number	2.1	91	8.	4.	95	9.3

<sup>1</sup> To the nearest hundred million pounds.

2 Values in parentheses below the regression coefficients are their F values. The degrees of freedom for error mean square declines by one for each successive equation beginning with d.f. = 14 for 2.1 to d.f. = 9 for equation 2.6.

3 Milk, beef and hog prices are U.S. annual average prices received by farmers deflated by the Index of Prices Received by Farmers, 1947-49=100 for the previous year. Milk prices are to the nearest tenth of a cent and hog and beef prices to the nearest cent.

4 Total hay supply is for the current calendar year beginning in May, to the nearest 100,000 tons. The content of this variable is somewhat unsatisfactory in that it does not completely represent the calendar year period of response. It can probably be considered mainly as exogenous and represidantly.

sentative of summer and fall pasture and roughage supplies.

§ Supply of total concentrates, for the year beginning the previous October, to the nearest hundred thousand tons.

that is belief. The variation simply which clastic cautiful is the additional study. Date that less

creas mode period twee degrition. the esion that ing the retain All for 1 point 2.6 fellong all pearlipare that

standard error. The short-run elasticity is .157, which may be compared with the value of .18 assuming complete adjustment within one year. After taking account of the coefficient of adjustment, however, the long-run supply elasticity turns out to be .398, or substantially higher than that for the short run, and somewhat higher than many of us might have believed.

The successive coefficients of adjustment increase rapidly as additional variables are included in the model. To me this is an indication that the simpler models may greatly underestimate the proportion of adjustment which occurs in the first year and consequently suggests higher long-run elasticities than are truly the case. Thus it seems inevitable that some caution must be exercised in interpreting results using this approach.

I should like to emphasize that this is not intended as a criticism of the approach, for any method improperly used may be misleading. In addition, I would like to note that Nerlove has called attention to the possibility that the coefficients derived by him may be susceptible to specification biases of the type described and has suggested that further

study of this problem is necessary.

Data for the period 1941-1957 were subjected to analysis similar to that for the entire period. It was argued that this was a period of much less uncertainty with regard to price expectations and substantially increased growth in technology. Thus separate consideration of these models for 1941-1957 was undertaken because of special interest in the period, and also to determine whether important differences existed between it and the overall results. In the eight-variable analysis only nine degrees of freedom remain, so the results must be interpreted with caution. Separate consideration of 1927-1940 was not undertaken because of the even more limited amount of data and the preponderance of depression data. The war years were included based on the personal judgment that the allocation of dairy farm resources was not seriously impaired during this period and special efforts were made to minimize the impact of retail price controls and rollbacks on farm income.

Although the general pattern of results is similar, comparison of results for 1941-1957 with the longer period 1927-1957 is suggestive on several points and raises questions on several others. Ignoring equations 2.5 and 2.6 for the moment, the coefficients of adjustment and both the short- and long-run elasticities are substantially higher for 1941-57 than for the overall period, 1927-57. Equation 2.4, comparable with model 1.4 mentioned earlier, gives short- and long-run supply elasticities of .286 and .526 compared with .157 and .398 for the longer period. This suggests, of course, that recent milk production is substantially more price responsive than it was prewar. The higher coefficient of adjustment is consistent with the

hypothesis of a greater certainty of price expectations in the war and postwar period.

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In equation 2.5, the introduction of beef prices in the model brings about some substantial changes in results although it improves the fit considerably, raising R<sup>2</sup> from .91 to near .95. Apparently beef prices (deflated) are closely enough related to changes in milk production during this period to reduce the coefficient of milk production in the previous year to a negative and nonsignificant value. This results in a coefficient of adjustment which is greater than 1.0 which doesn't make sense. The coefficient of milk price is greatly reduced from equation 2.4, although both it and the estimate of short-run supply elasticity are still greater than for the period 1927-57. The coefficient of the new variable, beef price, is both significant and sensible since farmers tend to cull their herds more heavily when beef prices are favorable and this should temporarily reduce milk output. But it is probable that in this latter period problems of multicollinearity are becoming significant for the larger equations.

A further item of some significance is the relatively greater size of the coefficients for hay and concentrate supplies in the 1941-57 period. This is consistent with the general trend toward reduction of cow numbers and heavier rates of feeding of the remaining cows resulting in increased production per cow and greater total production. The efficiency of feed conversion of dairy cows, of course, has also increased. Research results presented at the June 1958 meetings of the American Dairy Science Association indicate that at North Carolina,10 on the contemporary comparison method of analysis, artificially sired progeny produced 15.7 more pounds of fat and 366.0 pounds of milk, with no significant difference among the dams of the two groups. It was noted that daughter-dam comparisons showed no differences, but this was thought to be due to selection bias. At the same time the Wisconsin station<sup>11</sup> reported that Holstein artificials, on the contemporary comparison basis, showed gains of 10, 13 and 1 pound of butterfat and 255, 173 and 49 pounds of milk when classified by herds of initial low, medium and high herd butterfat average. Thus some of the effects of technology show up in the hay and concentrate coefficients.

<sup>&</sup>lt;sup>10</sup> W. L. Tucker and B. R. Farthing, "Genetic Improvement of Dairy Cattle Attributable to Sires Used in Artificial Insemination in North Carolina," University of North Carolina, paper presented at American Dairy Science Association Meetings, 1958.

<sup>&</sup>lt;sup>22</sup> N. J. Guderyon, E. L. Corley and J. W. Duckwall, "Performance of Artificially Sired Daughters and Their Contemporary Naturally Sired Herd Mates in Stratified Levels of Herd Production," University of Wisconsin, paper presented at American Dairy Science association meetings, 1958.

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The coefficients for time in the 1941-57 period in equations 2.5 and 2.6 appear to be involved in the multicollinearity problem previously mentioned and the fact that they are larger than for the longer period may not be significant. However they are consistently positive tending toward 300 million pounds of milk per year. In this formulation, the full effects of technology are perhaps hopelessly embedded in the coefficients for time, hay and grain and concentrates.

An attempt was made to determine whether the response relations were significantly different for years in which relative milk prices were rising from years when they were falling. There has been speculation over the years that milk production responses were different in these two situations. This analysis attempts to shed some light on this point.

In order to arrive at estimates for these two situations the data were classified by periods of rising and falling relative milk prices. In no case was a period of less than four years included. The results of this analysis are included in Table 3.

The response to price is not different by a statistically significant amount between periods of rising and falling milk prices. However, the milk price coefficients do tend to be higher during periods of declining prices than for periods of rising prices. The result is that the short-run elasticities appear to be higher during periods of falling prices than during periods of rising prices. This seems to be inconsistent with most hypotheses previously postulated for the nature of the kink in the milk supply relationship. Obviously further work will be necessary to test the correctness of this indication. Again it should be emphasized that these results are not statistically significant, so the existence of a kink remains in doubt, as well as its probable angle or direction.

#### Conclusions

Despite the probable relatively large measurement errors which are among the variance components of milk production and the other variables used in this analysis, it has been possible to derive a reasonably adequate estimate of the supply relation for milk production on a national aggregate basis. In most equations most of the coefficients appear to be sensible from the standpoint of sign and general magnitude and are for the most part at acceptable levels of statistical significance.

The supply elasticity of milk production in the short run of a year appears to have been in the range of .15 to .30 with strong indications that it has increased in recent years and is now in the upper part of this range. Estimates of longer-run elasticity indicate it to be in the range of .35 to .5 with indications that it too is near the upper end of his range. Changes in the coefficients of adjustment, indicating a tendency toward

Table 3. Milk Production<sup>1</sup> Analysis, United States: Statistical Results Showing Effects of Specified Variables for Periods

			THE PAINT OF TREMAINE WITH FRICES IS KISING OR FALLING	TO THE T	VIIVE MILK FR	ICES IS KISIN	G OR FALLING		
Equation	Milk price3	Time	Milk produc- tion previous	Total hay	Supply of total	R31.—	Coefficient	Supply	Supply elasticity
Riving Spring			year	. Aiddns	concentrates		adjustment	Short run	Long run
3.1r	.063	9.972				176.		.268	
93	.031	4.412 (8.13)	.572			.978	.428	.132	.308
3.87	.031	3.762 (2.06)	.580	.041		.979	.420	.132	.814
3.47	.082	4.096 (2.07)	.525	.024	.016	086.	.475	.136	988.
Falling prices 3.1 f	.049	10.330 (12.78)				989.		761.	
3.2 f	.048	3.032 (2.04)	.894 (26.65)			106.	.106	.193	1.821
3.8 t	.048	1.127	.597	.187		.943	.408	.198	.479
8.4f	.044	.420	.530	.196	.023	.945	.470	711.	.877

<sup>1</sup> To the nearest hundred million pounds.

<sup>2</sup> Values in parentheses below the regression coefficients are their F values. The degrees of freedom for error mean square are 16 for equation 3.1 r and are 11 for equation 3.1 f.

Milk, beef and hog prices are U.S. average prices received by farmers deflated by the Index of Prices Received by Farmers, 1947-49=100 for the previous year. Milk prices are to the nearest tenth of a cent and beef and hog prices to the nearest cent.

17 fold hay supply is for the current calendar year beginning in May, to the nearest 100,000 tons. The content of this variable is somewhat unstainfactory in that it does not completely represent the calendar year period of response. It can probably be considered mainly as exogenous and supply of total concentrates, for the year beginning previous October, to the nearest hundred thousand tons.

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greater production response to price in the short run in recent years imply relatively smaller increases in longer-run elasticities, or perhaps, conversely, that the long run is not quite so long as it used to be.

The impact of technology, working through the hay, grain and concentrate and time coefficients indicates rather substantial increases, particularly in the first two, in recent years.

There is some indication that there may be a slight kink in the milk supply curve but surprisingly the results suggest a kink in the opposite direction from that originally suspected.

Among other things not answered are questions dealing with regional differences in response. Such differences will probably be substantial. One of the major difficulties is that of getting data in a form suitable for analysis.

#### DISCUSSION: THE RESPONSE OF MILK PRODUCTION TO PRICE

JOHN R. KING

Doane Agricultural Service, Inc.

Halvorson's paper deals with possible answers to questions that are badly needed by those formulating agricultural policy. It is a well-documented paper and indicates the knowledge and vision of the author. For those in the dairy industry, it should be gratifying to know that their problems are not going unheeded.

atisfactory in that it does not completely represent the calendar year period of response. He considered mainly as exogenous and representative of summer and fall pastures and roughage augustive of summer and fall pastures and roughage supplies.

• Supply of total concentrates, for the year beginning previous October, to the nearest hundred thousand tons.

We are all aware of the short-run inelasticity of demand inherent in most agricultural food products and the resulting wide price swings accompanying changes in production. Regretfully, our empirical work does not reflect the distinction which is usual even in static economic theory, between short-run and long-run influences. Halvorson seeks an answer to the question: "How will milk production respond to price changes in both the short-run and long-run?" He has not used traditional regression analyses, but has formulated his model to yield simultaneous measurements of supply elasticity in both short vun and long run. Any attempt to rank factors affecting milk production response should be predicted upon a clear understanding of the supply elasticity and its implications.

Halvorson is very much aware of the technological advancement made by dairy producers since 1940. Those of us close to the operating level of agriculture will perceive the depth of his insight. Knowledge of this type is fundamental for really probing research. Because of this awareness, he chose to examine the data for the 1927-57 period, and also analyze the problem for the 1941-57 period. In this latter study, he included the war years, for he did not believe that the data was unduly distorted. I believe this is a sound conclusion.

Halvorson points out that much time and energy has been expended in researching the demand elasticities for food products. Elmer Working's Demand For Meat¹ is a thought leader in this field, for Working foresaw differences in the short-run and long-run demand for meats. His attempts to isolate and measure these differences were not the last word; he did not claim them to be. However, he succeeded in bringing the problem into clear focus and implanting ideas in the minds of other researchers. There is a striking similarity between Working's "dynamic" demand problem and the "dynamic" supply response envisioned by Halvorson. I cannot fully agree that it is more difficult to determine dynamic supply responses than dynamic demand responses. That there has been more effort expended upon the elasticity of demand than upon supply elasticity is true. This may be the basic reason why it appears that isolation of supply response is the more difficult at this time.

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The principle that as many relevant factors as possible should be included in the model was followed by Halvorson for he sought to avoid specification error. He believes that supply relations are more nearly valid than response relations.

There are significant conclusions drawn from the analysis: (1) The supply elasticity of milk production in the short run appears to have been in the range of .15 to .30. Estimates of longer-run elasticity indicate it to be in the range of .35 to .50. (2) Producer response is occurring at a more rapid rate in recent years, so that long-run adjustments are not as long as they used to be. These findings should be of value, if utilized by those responsible for determining agricultural policy.

<sup>&</sup>lt;sup>1</sup> Elmer J. Working, The Demand for Meat, Chicago: University of Chicago Press, 1954.

## RESPONSE OF THE FARM PRODUCTION UNIT AS A WHOLE TO PRICES

J. ROBERT TOMPKIN\*
Agricultural Research Service, USDA

THE LAW OF SUPPLY tells us that as the price of a product is increased producers offer more of that product for sale. My purpose here is to discuss to what extent farmers do this—what production adjustments they make, or can make, in response to price changes. This can be done in two ways: (1) setting forth theoretically the changes the operator must make, under given conditions, to maximize profits, and (2) reporting the adjustments an observed group of farmers actually made under changing price relationships.

Many different considerations influence organizational adjustments made by farmers, but this discussion is limited to allocation responses to

changes in prices of products and production factors.

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This paper is divided into four areas of treatment: (1) recognition of the challenge of science in agriculture and the part it plays in production adjustment; (2) farmers' use of theoretical considerations involved in production adjustments; (3) description of a sample group of farms and actual aggregative adjustments on these farms; and (4) positive and normative adjustments on an individual "typical" farm, linear programs.

### Science and Farm Adjustment

Scientific and technological advance in agriculture has been tremendous, particularly during the last three decades. Higher yielding and disease-resistant varieties of plants, antibiotics and hormones in feed, tractors and in-the-field harvesting machines, pest and disease controls, artificial insemination, and many other innovations have lessened physical labor and increased output per unit of input for farmers. Because of scientific progress both rural and urban living standards have attained a high level.

The scientific progress has also brought with it certain kinds of difficulties for farm operators. Interfarm disparities have tended to increase, and many marginal managers, as well as many operators who controlled too few resources, were forced to leave agriculture. No doubt society gained by the resultant increase in economic efficiency, but individual hardships were many. Decision-making becomes more complex in the farm firm as more alternative courses of action become available to the operator and

<sup>&</sup>lt;sup>o</sup> The author wishes to express particular appreciation to R. H. Baker, Ohio State University, and to Jerry A. Sharples, Farm Economics Research Division, Agricultural Research Service, USDA, for their aid in the preparation of this paper.

as technological uncertainty joins the other uncertainties with which he is

Scientific change has occurred also in nonagricultural industries and in the homes of consumers of farm products as well. Education and research have altered job distributions, patterns of living, specialization, diets, and even family structures. Merchandising, packaging, and distribution methods have been shifted. Thus society makes constant demands on agricultural producers, via the pricing system, to provide different

products in differing quantities at different times.

Farmers are thus faced with problems of adjustment in meeting these consumer requests. They must reorganize according to new productproduct, factor-factor, and factor-product relationships. They must not only interpret correctly society's present and future wishes, but they must also reallocate their productive resources in a way that will equate the marginal productivities of many resource elements, some of which are themselves new to the operators. Price and yield uncertainties are joined by technological and human uncertainties. The problem is further intensified by the fact that most farm-raised commodities are characterized by an inelastic demand. Therefore, small changes in total production are accompanied by correspondingly larger inverse changes in price. These decisions must be made under conditions of imperfect knowledge as to the actions of other producers.

This, then, is the situation in which farmers must plan their optimum

organizations for the coming production period.

Farmers' Use of Theoretical Considerations in Production Adjustment

Economic theorists have developed a set of maximizing principles which optimize the allocation of productive resources within the firm, between firms, and between industries or segments of the entire economy.

Most operators are aware of, and use in varying degree, the concepts of substitution, opportunity cost, and nonproportional output. Many farmers combine their enterprises according to supplemental, complemental, and competitive relationships. A small proportion of the operators I have contacted know something about simple marginal concepts and realize that inputs should not exceed equality of marginal costs and marginal revenue. A larger number are inclined to make decisions based on average rather than marginal values. To many farmers understanding of scale implications appears to be limited to the idea that a smaller farm is more limiting and that greater resource utilization and larger returns are more obtainable on a larger farm.

Very few farm operators I have contacted, however, have any formal notion of marginal substitution or transformation rate ratios as resource alloca cultur three

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allocators. Extension economists would perform a real service to agriculture if they could simplify and present to farmers in practical form, the three basic maximization principles as follows:

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1. Product-product relationships. With resources fixed in quantity, the marginal rate of substitution between products should be equal to the inverse ratio of the prices of the competing products.

Factor-factor relationships. In the production of a given amount of product, the marginal rate of substitution between factors should be equal to the inverse ratio of the prices of the factors.

3. Factor-product relationships. This simply combines 1 and 2 above to state: The proper combination of products and factors requires that the marginal rate of substitution of factors be the same as the marginal rate of substitution of the products.

We know, of course, that farmers do not view these adjustment "guiders" in the same formal sense as professional economists. But the most competent operators employ "rules of thumb" that are frequently so close in net result that I wonder whether their rules are progeny or progenitors of existing economic principles.

#### Aggregative Adjustments on an Observed Sample of Farms

In January, 1956, the Ohio agricultural experiment station and the Farm Economics Research Division, Agricultural Research Service, USDA, initiated a study of operational adjustment alternatives on farms in west-central Ohio. This project was to run for four and possibly for five years. A nine-county area was selected as somewhat more representative of general corn belt farming than would be a sampling of the entire state.<sup>1</sup>

The topography of the sample area varies from nearly flat in some sections to rolling in other parts. Soils are silt loams, clay loams, and some sandy loams. Rainfall averages about 38 inches per year. Some part-time farming exists but is usually restricted to smaller units than those used in our sample. Hog and general livestock farms predominate, although some dairy and a few cash grain farms also came into our random sample.<sup>2</sup>

<sup>&</sup>lt;sup>1</sup>In 1954, Ohio had about 22 per cent of the commercial farms found in the four-state area of Ohio, Indiana, Illinois and Iowa; it produced 14 per cent of the corn, 34 per cent of the wheat, and 21 per cent of the hay grown in these states. By comparison, the selected project area comprises 10 per cent of Ohio's agricultural acreage but produces 18, 15.5, 15, and 11.5 per cent of the state's output of corn, wheat, oats, and hay, respectively. About 26 per cent of the cropland is planted to corn as compared with 17 per cent for the entire state. These statistics were taken from the 1954 Census of Agriculture, Bureau of the Census.

<sup>&</sup>lt;sup>2</sup>We isolated the 140-180 acre owner-operator farms in the area, numbered them, and drew 150 numbers randomly. We then visited these farms. After one visit we reduced our sample number to 35 typical farms. We revisited this subsample in 1956, and again in 1957 and 1958. The same procedure was followed on the 320-acre farms, starting a year later. At the present time, we have two complete years of data for the 160-acre farms and one year for the 320-acre units.

Cow-calf, sheep, and poultry operations appeared on some farms as minor supplemental enterprises, and a few operators derived the major share of gross returns from fattening feeder cattle. Crop rotations on the live-stock farms varied from corn-small grain-meadow to corn-corn-small

grain-meadow, depending on the intensity of hog production.

The discussion to follow will deal only with 160-acre general livestock farms. Our data are too limited, as yet, on the 320-acre units. There are not enough cash grain farms to give reliable answers over a short period of observation. The only changes in organization we could detect on the dairy farms in 1957 as compared to 1956, were an increase in feed inventory, a reduction in corn acreage to allow an increase in hay and small grain, and a 30 per cent increase in fertilizer use. The number of cows per farm was the same in the two years. This lack of any important resource adjustment was probably due to the contractual nature of the dairy enterprise, and the fact that the base price of milk increased only only about 10 cents per hundred-weight in 1957.

During the period of study, no severe resource rationing was apparent on the livestock farms, with the exception of land. Very little additional land was available for rent. Seasonal labor only was hired. Short term credit was generally available at interest rates of 5 to 7 per cent. No significant change occurred during 1956 and 1957 in market prices of

land, labor, or capital factors.

Group production response to price in a given year (P) appears to depend upon one, or a combination, of two factors: (1) the price the operators received for that particular product in year P minus 1 as compared with the price received in P minus 2, and (2) the price the operators expected to receive in year P. Price expectations for the major products were plotted, and a high standard deviation was found for all except corn and wheat. The loan program on these, of course, provides a type of forward pricing that apparently is reassuring to producers.

Charts A, B, and C of Figures 1 and 2 show production levels of the sample farms for 1956 and 1957, together with the quarterly average prices received by Ohio farmers. The X axis represents the years, by quarters; the left Y axis is the price of the product, and the right Y axis is a measure of production units per farm. Production level is shown with no time lag with price and with a year time lag. In the case of hogs, a six-month lag is also shown, and for beef cattle a three and four year

lag is included.

Figure 1 shows that the acreage of corn increased noticeably with no apparent price stimulus. We attribute this increase to the rise in hog prices in 1957. Neither the production nor the price of oats shows any significant action. The two-acre-per-farm increase in wheat acreage was

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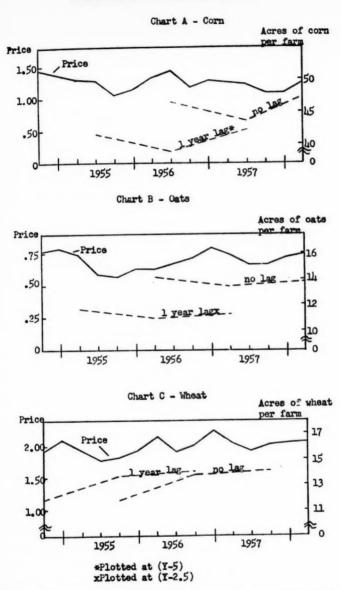


FIGURE 1. PRODUCTION RESPONSES OF SAMPLE FARMS TO GRAIN PRICE CHANGES

caused by fuller utilization of wheat acreage allotments and operators' expectations for a 1957 price somewhat higher than the actual price in 1956. I might add that the expected price did not materialize.

Operators expected about a 50 cents per cwt. higher price for lambs in 1957 than they received in 1956. A price increase occurred just prior to

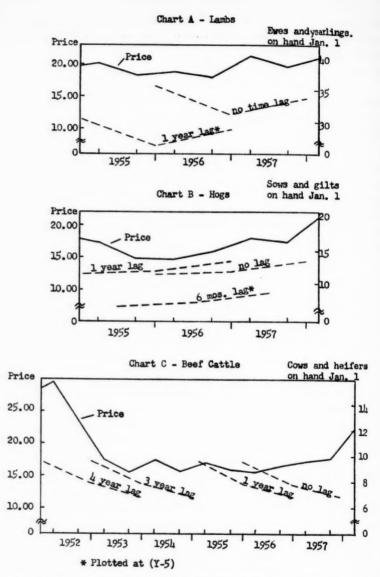


FIGURE 2. PRODUCTION RESPONSES OF SAMPLE FARMS TO LIVESTOCK PRICE CHANGES

breeding in the fall of 1956. These are the only reasons we can see for the slight increase in sheep numbers in Figure 2.

In Chart B, Figure 2, hog production shows a definite response to price increase. The hog producers in the sample received a 20 per cent higher price for fat hogs in 1957 than in 1956. The increase in price started in

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the spring of 1956 and continued upward through 1957. The six month and the one year production lag fit very well with the price movement. Operator's expected price for butcher hogs in 1957 was \$1.30 per cwt. above the actual prices received in 1956.

In Chart C, Figure 2, there is hardly enough cow-calf operation to reflect adjustment response reliably. The three- and four-year lags apparently indicate a little response to price, which probably was not statistically significant. Those operators who planned to have fat steers and heifers to sell in 1957 expected to receive about 2.5 cents per pound more than the 1956 prices, but the few operators who bought feeder calves paid about \$20 per head more for the calves than they had expected to pay.

The \$2.31 average price received by these operators for soybeans in 1956 stimulated a 48 per cent increase in bean acreage in 1957. Actually, this is not as startling as it sounds because the mean acreage increased only from 5.4 acres per farm to eight acres in absolute terms, with modal production at about 19 acres.

There were two other indications of response to higher prices in 1957. Purchases of fertilizer and lime increased from \$616 per farm in 1956 to \$704 in 1957, or an increment of \$88 per farm; subtracting the trend effect gives \$88 - \$33 = \$55, or about a 9 per cent increase over 1956.

The other adjustment, which apparently was stimulated by rising hog prices, was a significant increase in the quantity of protein supplement bought by the farmers. At the beginning of the 1956 production period, the operators expected to buy only about \$700 worth of supplement. When hog prices began to rise in the spring of 1956, these farmers actually spent \$1,400 for supplement in 1956 and more than \$1,700 per farm in 1957.

No distinguishable adjustments in machinery or labor could be attributed specifically to changes in product prices during the period of study. Cash expenses on this group of farms increased 8 per cent in 1957 over 1956, but this coincides with the trend increase in the prices of items farmers buy.

The sample farmers kept about 500 bushels more corn in the January 1, 1957, inventory than they kept a year earlier. The assumption is that this was intended to feed the increase in sows and gilts for 1957. As mentioned earlier, no significant decrease in numbers of beef cows and heifers can be inferred, but the farmers who fed out feeder calves had increased number of calves and yearling steers on hand January 1, 1957, as com-

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 $<sup>^3</sup>$ Trend effect adjusted to the 128 crop acres on the sample farms, was computed at \$33 per year. From 1940 to 1954, trend was \$19 per year in Ohio for the average of 72.28 crop acres.

pared with January 1, 1956. This was in line with the operators' expected higher prices in 1957.

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Perhaps I should point out here that no claims are made that price changes are completely responsible for these shifts, or that all adjustments mentioned are significantly different from what the operator would have done under conditions of completely stable prices. However, no group changes were found that appeared to be inconsistent with price actions or the operators' expectations of price actions.

A two year period of data doesn't permit a researcher to make many positive statements on adjustments to change in price, but I think that some of the theoretical concepts mentioned in section 2 show up in the actions these farmers took. In the hog enterprise, in particular, as the price line moves upward to a greater degree than the marginal cost line moves to the left, production in that enterprise should move to the right. I think this happened on these farms. The increase in use of fertilizer and protein supplement indicates an application of the substitution principle. Opportunity cost may be reflected in the withholding of corn from the market to be used as feed for additional hogs. There does appear to be a slight shift in product-product and product-factor relationship as the price relationships of the products changed from 1956 to 1957. To establish how perfectly the reallocation was accomplished will require more data and more analysis.

#### Individual "Typical" Farm Adjustments: Linear Programming

To evaluate properly the production changes made by the sample group of farmers, a standard of comparison was necessary. The best possible comparison should be that made against the ideal or optimum resource allocation under the prices these farmers received for their products in 1957 and using the production factors actually available to them. Accordingly, a "typical" 160-acre livestock farm was set up using the production coefficients used by the modal farms in the group. Actual

<sup>\*</sup>Production rates and prices used were those actually obtained by the operators in 1957. Corn, oats, wheat and hay yields were 66.4, 36.3, and 26.1 bushels, and 1.78 tons/acre/one cutting, respectively. Yields for 1957 were cut by a very late, wet spring in this area. Pasture yields were computed in animal unit pasture days, using July as the most limiting month, and pasturing hay-ground after 1 cutting. Spring pig litters averaged 7.12 pigs weaned and fall litters 6.73. Spring and fall pigs were sold at 210 and 216 pounds at \$18.55 and \$17.90, respectively. Sows were sold at 416 pounds at an average price of \$16.20/cwt. Feeder calves were bought in late fall of 1956 at 375 pounds and an average price of \$19.92. They were sold in the fall of 1957 at 920 pounds at \$23.00. The poultry enterprise had chicks in at 31 cents each, hens out at 75 cents, and 160 eggs sold per opening-inventory hen, at 36.1 cents per dozen. Permanent pasture was limed every six years at 2 T/a., and phosphate was applied at an average rate of 100 pounds per acre per year. Available capital of \$13,205 included \$5,003 as value of livestock in January 1, 1957, inventory, \$4,038

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1957 production rates, prices received, acreages of cropland and permanent pasture, machinery, available capital, and availability of housing were used in a linear programming<sup>5</sup> analysis to determine optimum organization.

These assumptions and conditions were used: (1) Fixed costs of land, nermanent buildings, and machinery were ignored until the end of the solution, at which time these fixed costs were included to permit determination of final family labor earnings.6 (2) Available capital includes market value of livestock and feed in the January 1, 1957, inventory, nlus liquid assets immediately available to the operator through present ownership or short-term loan, minus current liabilities. The possibility of raising capital through the mortgaging of real estate was excluded. (3) Labor resource available includes operator's labor, unpaid family labor in the amount declared by modal operators, and the mean amount of hired labor actually used on these farms. Labor requirements were computed by months for several likely systems of enterprise combination, and April and October were found to require the largest amount of labor of any months of the year. These two months were used as labor restrictions in the matrix. (4) The acreage values used were 128 acres of cropland and 11 acres of permanent pasture. A corn-corn-small grainmeadow rotation was used, with one cutting of alfalfa hay taken from half the meadowland. This ground was pastured after one cutting of hay. The other half of the meadow was alfalfa rotation pasture. Pasture output was measured in terms of animal-unit days. (5) Wheat acreage was permitted to come into the rotation only up to the wheat acreage allotment. (6) A machinery charge was made against the rotation activity but it did not include the costs of taxes, insurance, or interest on investment. These are included in fixed costs added at the end of the solution. (7) It was assumed that these farmers did not want a dairy enterprise (actually most of them do not), so no dairy alternative was included. (8) No provision was made for off-farm employment. Full-time farming was assumed. (9) Perfect knowledge of everything was assumed as this was an ex post analysis.

Available resources as of January 1, 1957, are shown in the Po column of the matrix labeled Table 1. Also appearing in the Table are the alterna-

W. W. Cooper, and John A. Henderson, An Introduction to Linear Programming,

New York: Wiley and Sons, Inc., 1953.

opening-inventory value of feed and grain, and \$4,164 which the operators declared as on hand as liquid assets plus short-term credit they were certain they could get. For a detailed explanation of linear programming procedure see A. Charnes,

<sup>\*</sup>The measure of final returns used was family labor earnings. This is operator's labor income plus value of unpaid family labor plus value of house rental. All farmraised products were considered as sold.

Table 1. Matrix for Program, Using Actual 1957 Prices

Kind of resources available	Unit	Available Jan. 1, '57	P <sub>1</sub> to P <sub>11</sub> slack vectors	Hogs spr. Hogs spr.	Pus Hogs spr. only	Pu Hogs fall only	Pu Beef steers	P16 Poultry	P <sub>17</sub> Rota- tion	Past.	Pis Buy corn	Pre Sell corn	Pn Buy oats	Pre Sell oats	Pra Buy hay	Pa Sell hay	Sell wheat
Activity unit				BOW	80W	MOS	str.	hen	18.8A	acre	bu.	bu.	bu.	pa.	ton	ton	pa.
Cropland	acre	128							12.8								
Corn	bu.			202	116	120.7	45	.53	-425		-1	1					
Wheat	bu.							.25	-49.6								-
Oats	bu.			90	325	88.7	10	88.	-47.8				7	1			
Hay	ton			1.	-:	10.	80.	.005	- 2.85						-1	1	
July rot. pasture	A.U. day			17.1	16.7	6.4	25.5		8.09-	-7							
Permanent pasture	acre	=								1							
Capital	doular	13205		387.1	248.46	259.54	95.71	8.99	283.90	8.83	1.85		.79		18.50		
April labor	hour	878		3.5	30.55	1.1	9.	s.	10.14								
October labor	hour	405		6.5	8.8	8.8	2.5	o;	13.99								
Feb. L.S. space	sq. ft.	3350		86.8	16.2	8.96	18										
Net income (CJ	dollar			400.95	192.85	161.64	110.84	1.90	-898.34	-8.50	-1.85	1.88	79	.64	-18.50	16.50	1.92

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<sup>7</sup> Sp efficient these c <sup>8</sup> Inc pasture the live activity columna availabe could <sup>9</sup> The gardene and co-buildin

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tive activities available to the operator. Activities that appeared to have very little likelihood of coming into the optimum solution were disregarded. The resource requirements for each unit of activity also appear in Table 1, as well as the actual prices received and paid by the operator's for corn, oats, hay and wheat. Cost per unit is shown under each activity on the "capital" row. Income per unit is shown on the last line of the matrix. Purchased hay and grain are shown with negative income in the amount of the purchase price per unit. The rotation and permanent pasture activities also show negative incomes. S

The optimum organization as derived by the programming is shown in Table 2. Also included are the total productions and resource uses of each activity contained in the final organization, and the quantity of production factors left unusual. Income per activity unit and total income also are contained in Table 2. The reader will note that "income per unit" shows negative figures for rotation, permanent pasture, and the feedbuying rows. This was explained in the preceding paragraph. There is one exception: In the feed-buying rows, the negative income exceeds the purchase price of that feed by an amount equal to interest on investment on the purchasing funds for the length of time those funds were invested in the purchased feed. The conclusion of the Table deals with the conversion of total activity incomes into family labor earnings (see footnote

The optimum organization consists of 22 sows under a two litter system, 13 feeder calves purchased and fed out to 920 pounds, the entire 128 acres of cropland included in the rotation, and 11 acres of permanent pasture used. The operator must buy 845 bushels of corn and 693 bushels of oats, but he has 496 bushels of wheat and about 16 tons of hay to sell. Unused resources amount to \$29 of capital, 16 animal-unit days of pasture, 156 hours of April labor, about 26 hours of October labor, and

<sup>&#</sup>x27;Space limitations in a paper of this type prevent a detailed breakdown of coefficients used, but they are available for anyone interested. As explained previously, these costs do not include fixed costs of land, buildings, and machinery.

Income from permanent pasture is reflected in the sale of animals utilizing the pasture. This was done by internal transfer into the July rotation pasture line where the livestock activities have access to it. The same principle applied to the rotation activity. Income from rotation goes into sales of livestock and crops as the transfer column feeds the various crop productions into their respective rows and are made available for livestock feed, or the surplus for sale. Direct crediting and withdrawal could have been done, but this device is simpler and equally effective.

<sup>&#</sup>x27;This is a sort of hybrid-type of income at this point. When house rental and garden value (we assume that other farm-grown products are all sold) are added to it, and costs of hired labor in April and October are subtracted, and fixed costs of land, buildings, and machinery are subtracted also, we obtain family labor earnings. This is actually operator's labor income plus house rental and garden value plus allowance for unpaid family labor.

Table 2. Optimum Combination and Family Labor Earnings, Actual Prices, 1957

	1	Optimum	Tot	al feed used	Total feed used and produced*	*P		-	Resources used	P		Income	me
Activity	CBIT	amount	Corn	Oats	Wheat	Hay	Capital	Rot. past.	April labor	Oct. labor	L.S. space	Per unit	Total
Hogs (2 litters)	80W	93	bu. 4510	bu. 1100	pa.	ton 2.2	7416	A.U. days 376.2	hour 77	hour 143	8q. ft. 2116	400.95	8831
Beef steers	steer	18	585	65		10.4	1244	292.2	6.6	32.5	934	110.84	1441
Sell wheat	bu.	496										1.92	952
Sell hay	ton	15.9										16.50	262
Rotation	acre	188	4650*	47.6	496*	28.5	6888	*809	101.4	139.9		-30.73	-8983
Perm. pasture	acre	11					87	7.7				-8.50	- 38
Buy corn	pa.	845					1141					-1.39	-1175
Buy oats	bu.	693					499					74	- 513
Resources left							68	16.3	188.1	89.6	1000		
Hired labor available but unused									98.0	64.0			
Net resources unused	F						68	16.3	156.1	25.6	1000		
							Іпсоше	Income column total					5817
							Value of	Value of house rental and garden	nd garden				625
							Total fa	Total family earnings					6446
							Fixed cos	Fixed costs on land, buildings and machinery	ildings and m	achinery			3987
							Cost of h	Cost of hired labor used	_				0
							Family	Family labor earnings					2455

• Items produced are marked with an asterisk; those used are not so marked. † This is income per activity unit.

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TABLE 3. COMPARISON OF ALTERNATIVE FARM ORGANIZATIONS IN 1957

Activities	Unit	Linear program solution Actual prices	Linear program solution Expected prices	Actual farm organization on modal farms
Hogs-2 litter system	sow	No. units 22	No. units 18	No. units 15
Beef feeder steers	steer	13	16	50 ewes <sup>a</sup> 18 feeder clvs.
Chickens	hen		540	150
Corn sold	bu.			
Corn purchased	bu.	845	446	400
Oats sold	bu.			
Oats purchased	bu.	693	659	200
Wheat sold	bu.	496	361	400
Hay sold	ton	15.9	11.2	
Hay purchased	ton			
Family labor earnings		\$2,455	\$978	\$1,801

<sup>&</sup>lt;sup>a</sup> Operators were divided between feeder steers and sheep enterprises. The modal value for those with sheep was about 50 ewes, for those with feeder calves about 18 calves.

1,000 square feet of housing space. Adding \$625 for house rental and garden value and subtracting \$3,987 fixed costs on land, buildings and machinery, leaves family labor earnings of \$2,455. Interest on owned investment was allowed at 5 per cent.

Another program was run using the same coefficients as before but substituting the operators' pre-production expected prices for prices actually received in 1957. I wanted an approximation of loss of income these farmers suffered because of errors in price prediction. These expected prices differed from actual prices in terms of level of price and in price relationships. In general the operators were too conservative in their estimates. The optimum combination, had these prices materialized, is shown in Table 3, in comparison with the allocation using actual 1957 prices. The family labor earnings under expected prices were \$978, but most of the April and October labor, as well as capital, was used.

<sup>&</sup>lt;sup>10</sup> Prices used were: \$17.18 for hogs sold in the spring of 1957, \$16.58 for 1957 spring pigs sold in the fall, \$16.18 as purchase price of feeder calves in fall of 1956, and \$21.00 selling price the next fall. Eggs were expected to bring 34.2 cents. Expected prices for crops to be sold were \$1.18, \$.62, \$1.97, and \$18.00 for corn, oats, wheat and hay, respectively. Farmers expected to buy corn, oats, and hay for \$1.19, \$.75, and \$18.00, in that order. Packer sows were expected to bring \$13.55.

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The next step was to compute the organization to which the modal operators adjusted in 1957, and the returns they received. Because of the sharp increase in the price of hogs and beef cattle, they fared better than had their expected prices prevailed. The actual family labor earnings for 1957 for the modal group of farms were \$1,801. Their organization is shown in Table 3.

We substituted actual prices into the optimum solution for farmers' expected prices, but retained the same enterprise combination. Family labor earnings were \$2,264, or within \$200 of the returns from the programmed solution computed from actual 1957 prices.

A few conclusions can be drawn from the information we obtained in west-central Ohio: (1) These farmers attempted some adjustment to prices. Apparently they prefer to wait until it becomes obvious that a product price is up or down for longer than a one year period. (2) As a group, they seem to make more adjustment to price changes which have already taken place than to their own future price expectations. (3) They appear to take more positive adjustment action when they have the reassurance of forward pricing.11 (4) Income can be increased through resource adjustment if some idea of price relationships is known. Perhaps this is a challenge to our outlook and extension personnel. (5) In 1957, these farmers would have gained by more completely adjusting to their expected prices instead of the organization they adopted. Prices they actually received nearly optimized the allocation to expected prices. (6) A longer period of study than two years is needed to give more reassuring answers to this problem. The current project is being continued and we hope to develop more definite results.

## DISCUSSION: RESPONSE OF THE FARM PRODUCTION UNIT AS A WHOLE TO PRICES

JAMES S. PLAXICO
Oklahoma State University

Tompkin's paper is concerned with a problem which is, and will continue to be, of first order importance in this age of scientific advance and agricultural adjustment. The research which Tompkins reports is clearly a worthwhile addition to our store of knowledge in the area of firm production response, and he is to be congratulated on the concise manner in which his research has been presented. It is a pleasure to discuss such a well-organized paper.

<sup>&</sup>lt;sup>11</sup> A correlation run on price and production of wheat in Ohio since 1948 gave r = .669, which was significant at the .05 level of probability. Since the Agricultural act of 1949 a loan price for wheat has been announced prior to the beginning of the production period. Correlations with nonloan commodities gave no significant relationships.

Most modern research in agricultural economics is designed to measure relationships. Too often, however, as we construct conceptual and empirical models, we fail to explicitly specify, identify and classify the relevant variables. The purpose of the Ohio research is to determine the nature and extent of production adjustments farmers make or should make in response to price changes. The two methods selected to measure such changes are (1) to observe changes actually made by farmers over a given time period, and (2) to program optimal changes. Upon casual inspection these two approaches would appear to provide estimates of (1) farmers actual response to price changes, (2) profit maximizing adjustments. Yet closer examination leads one to wonder if the first approach (i.e., observation of farmer adjustments) is capable of reflecting supply adjustments to price changes.

It is, I believe, exceedingly helpful at both the conceptual and the empirical levels to recognize the important differences between response relationships and supply relationships and between supply relationships over different time periods. Supply relationships have been defined to be changes in supply or output due to price changes and may relate to varying time periods ranging from the very short to the very long run. The response relationship is the response of output to the complex of technical, economic, and institutional stimuli which determine output levels.

Although the stated purpose of the Ohio research is to isolate supply relationships, it would appear that the data relating to observed farmer reactions is more nearly a response relationship. Thus, observed responses may be attributed to changes in product-factor prices, technology, capital limitations, uncertainty, and other monetary and nonmonetary stimuli. It is difficult to see how one would derive a net price supply relationship from these data. Furthermore, if the observed changes in output levels are a consequence of price changes alone, the derived supply relationship may be either short-term or long-term.

From a methodological or technique standpoint, the simple correlation coefficients between price and output would aid the reader to better interpret the farmer results presented. Also we have secured some rather promising, or at any rate plausible, results by simply asking farmers what changes they would make in response to certain price changes. This approach may be one method of isolating supply relationships.

The Ohio programming model is, of course, designed to estimate movements along the short-term supply relationship. This is the case because land, buildings, machinery, labor, capital, etc., are taken as fixed resources. In addition, the prices used are those expected over the short run. If we are to utilize programming models to estimate longer-run supply relation-

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<sup>&</sup>lt;sup>1</sup>James S. Plaxico, "Supply Concepts and Aggregation of Firm Supply Functions," in James S. Plaxico, et al. (Editors), Farm Size and Output Research; A Study in Research Methods, Southern Cooperative Series Bulletin Number 56.

ships, it would appear that it will be necessary to develop models that allow asset structures to be endogenously determined.

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Despite the fact that, conceptually, the observed farmer responses are not comparable with the programmed predictions, the results from the Ohio study are remarkably similar. Tompkins suggests that few of the farmers in the sample possessed a working knowledge of marginal relationships. Yet considering the apparently near optimum short-run position of the sample farmers, one wonders just how much an extension specialist might contribute by teaching formal static marginal analysis to these farmers. However, if such instruction could cover such topics as changing asset structures over time, I would agree that such an undertaking could be helpful.

Tompkin's farmer adjustment results can be exceedingly valuable for they will provide an insight into the characteristics of farms and farmers most likely to adjust output levels. However, I doubt that the farmer response data constitute an adequate estimate of the firm supply relationship. Thus I don't believe Tompkin's results will allow him to make meaningful statements relative to the effect of product price changes on the levels of production of individual products or total output of different types and sizes of Ohio farms.

Despite the anticipated importance of the Ohio research, the important question, "What is the nature of the total farm unit supply relationship?" will remain a challenging mystery. Certainly, the Ohio programming model will yield useful indications of short time individual product supply relationships. Yet theory suggests that, given an asset structure for a firm, the opportunity cost principle determines the level of output for individual products. Thus as price ratios change, additional units of one product are produced primarily because the output of another is reduced. Obviously a programming model which includes an exogenously determined structure of fixed assets can only reflect the magnitudes of such intrafirm product substitutions, or movements along the short-term supply relationship. It cannot predict the conditions under which the firm will alter its asset structure.

If we are to empirically solve questions of firm supply relationships in agriculture, we must develop a rigorous means for conceptually and empirically handling the age-old problem of asset fixity. It would appear that the Ohio research could be profitably extended to investigate farmer attitudes and responses to long-run variables that stimulate alterations in asset structures. Once the nature of firm responses are known, perhaps we can turn our attention to the response of the industry as a whole. This step will require the solution to some extremely complex problems of aggregation and a knowledge of the nature of the factor supply market for resources used in agriculture.

#### FINANCING A DYNAMIC AGRICULTURE

Chairman: Fred L. Garlock, Agricultural Research Service, USDA

#### INTERMEDIATE-TERM CREDIT IN AGRICULTURE

STANLEY A. MORROW Federal Intermediate Credit Bank of St. Louis

In PREPARING this paper I am assuming that those here are well aware of the tremendous changes that have taken place in methods of farming over the past several years and that you have a reasonable knowledge of the Farm Credit system and the way in which it operates. Therefore, comments about the system and the changes in methods of farming will be limited to background facts and an analysis of the farmer's need for intermediate-term credit and the progress made in

supplying this need will be attempted.

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The Farm Credit system as it is known today is comprised of three separate, cooperative lending organizations designed to serve the agricultural needs of farmers. The Federal Farm Loan act of 1916 provided for the establishment of federal land banks and national farm loan associations to provide, on a cooperative basis, real estate mortgage loans designed to enable the farmer to pay for his land from normal production. In 1923 the Federal Farm Loan act was amended to provide for the establishment of a Federal Intermediate Credit bank in each of 12 farm credit districts. The Federal Intermediate Credit banks are financial institutions of discount for agricultural loans. They do not deal directly with farmers or stockmen, nor do they receive deposits, or otherwise conduct a general banking business, but rather serve as wholesalers of credit to lending organizations financing the credit requirements of individual farmers and stockmen. The need for more adequate sources of short-term agricultural credit became apparent in the early 1930's, and in 1933 the Farm Credit act provided for the organization of the production credit system. The production credit associations set up under this system are composed of farmers who borrow from the association to meet their short-term and intermediate-term agricultural needs. On January 1, 1957, pursuant to the provisions of the Farm Credit act of 1956, the production credit associations were placed under the supervision of the respective Federal Intermediate Credit banks. The production credit associations make the loans to the farmers, and the Federal Intermediate Credit banks finance the loans for the associations. Similarly, there was a need for a more adequate credit system for farmer cooperatives. Under the Farm Credit act of 1933 provision also was made for 12 district banks for cooperatives and one central bank for cooperatives. These banks

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for cooperatives offer complete credit service to eligible cooperative associations where farmers act together in processing, handling, or marketing farm products; or, purchasing, processing, and distributing farm supplies. Briefly, these are the three banks that provide a complete cooperative credit service for farmers, but we here are concerned with the Federal Intermediate Credit banks and the production credit associations through which intermediate-term credit is now available to farmers.

While there is no doubt that there is great similarity in the needs of farmers throughout the country for intermediate-term credit, this paper concerns itself more specifically with conditions in the sixth district and the policy of that bank. However, the sixth farm credit district comprises the states of Illinois, Missouri, and Arkansas, thus encompassing widely diversified farming interests including cattle operations, general purpose units, corn, wheat and cotton production, and speciality enterprises, which operations are fairly representative of agriculture as a whole. Policies here may not be entirely in keeping with those carried out by other districts and I do not desire my remarks to be construed as policies

to be adopted by the other banks.

There is no doubt that today farmers have a real need for intermediateterm loans in their financial program. Methods of agricultural production have been undergoing revolutionary changes. To keep abreast of these changes and to continue in business, farmers are compelled to expand their operations, improve their farm units, and at times, shift from one type of farming to another, all of which are costly. With the exception of long-term real estate financing, the farmer has, until recently, depended primarily upon annual maturities for his credit needs. However, a greater demand for credit has been brought about by the tremendous increase in capital investment and the very substantial increase in production costs. Credit on a longer term basis for many units is just as essential to the sound financial operation of a farm today as short-term credit was when farming left the stage of barter and trade or merchant carry to supply the essential costs of seed, feed and annual recurring expenses. Today it is extremely important for the farmer to analyze his total credit requirements and to plan an over-all program which will permit debt reduction coincident with the materialization of income from his operation. Some capital items are of a productive nature and help increase income, improve capacity to repay, or cut production costs, yet others are nonproductive and, while improving living standards, add little or nothing to income.

All of this has a bearing on financial planning. If a farmer is borrowing for a capital investment, then he must decide whether borrowing for such a purpose should be on a short-term basis, a long-term land mortgage, or

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such e, or over the period of an intermediate-term loan. To make this decision it is essential to have a farm plan which projects the repayment capacity sufficiently far into the future to determine the period for which the debt should be contracted. Because of these factors, the farmer must have a flexible and dependable source of credit. If he is a landowner he should consider a sound, long-term real estate loan for heavy capital purchases, such as that the Federal Land banks offer, providing for orderly reduction of the debt annually. Whether a landowner or a tenant, he must have a source for his short-term credit needs fitted to a repayment plan that coincides with the time his income will materialize. In addition, in many instances these two sources do not suffice and it is necessary that an intermediate-term loan be available for him to take care of capital investments where only a portion of the debt need be repaid annually.

Before telling you of the plan followed in our district I would like to point out some of the problems involved from the standpoint of financial institutions in adjusting a credit program to meet these needs. There are a number of reasons why credit organizations are slow to institute changes in financing. I am not going to alibi this slowness but I think we should take a look at some of the basic reasons for caution. Every financing institution is lending someone else's money and owes an allegiance to its investors. It also has a grave responsibility to its patrons. Credit can either help the patron or break him. Any revolutionary development-be it in labor, commercial business or agriculture-causes a certain number of failures and movement of people from one business to another. Training and education are important and take time. It is no longer sound or practical for a financial institution to lend on the basis of ample security. Farming today is big business. Family units must be substantially larger and they require greater amounts of credit to carry on their operation. A farmer can no longer stay in business on the basis of hard work, willingness, and honesty. He must have ability in both farm and financial management. The average size loan in our district used to be from \$1,000 to \$1,500. Today, the average size loan is between \$6,000 and \$7,000. Soundness of the unit, capacity to repay, and managerial ability are important facts that must be known before a decision is reached to extend credit and particularly before maturities are extended for a longer period than has formerly been the case. It is quite different to lend a small amount of money for a few months with repayment pretty well in sight than it is to extend credit over a five year period. Credit can be helpful in assisting the farmer to make necessary changes if based on proper terms and conditions, but it can also ruin the man who does not have the facilities or the ability to get the job done.

Thus one of the big problems for any financial institution is to help

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the farmer project his financial plan over the necessary period of time to permit him to accomplish his proposed program. Just to investigate a farmer's honesty is no longer sufficient, and his ability to do the job is oftentimes harder to determine. Many operators can produce cotton, com or soybeans but lack the ability to adjust their unit to new projects. Today's changes make some of these adjustments essential to sound farming Extending the time of debt repayment is no substitute for adequate capacity to repay or managerial ability to get the job done. There is another very important factor that the lender must consider and that is the ability of his own organization to furnish the type of credit required. Going into larger amounts of financing and longer maturity loans requires more capital and a definite assurance of dependability of funds. The financing institution must have capital strength sufficient to permit it to stay with the sound farm operator who may suffer reverses beyond his control due to natural hazards that are inherent in the farm business. It must also be sure the source of funds can remain outstanding without damage to its customers over the period required by the farmer.

Farmers have not necessarily been penalized by lack of credit for capital purposes over the past years since the production credit system has, since organization, allowed three years to pay for capital items by maturing the notes annually and renewing any capital credit that could not be paid from annual income. However, this has not been a satisfactory procedure in all cases from the farmer's standpoint and particularly so now with high operating costs, narrow margins of profit, and heavy capital requirements. The Federal Intermediate Credit banks have always been permitted by law to make loans up to three years, but policy-wise, up until a few years ago, it was felt advisable for the banks and the production credit associations to limit maturities to one year and renew balances in order to better supervise and adjust credit annually to changing conditions. For several years the question of longer maturities was under consideration, and in 1954 some districts started to experiment with longer maturities for major capital improvements and heavy machinery purchases. A poll of production credit associations in our district at that time did not indicate any interest. However, by 1956 the decision was reached that a better service could be rendered in many cases if some capital items were placed on a longer-term basis, and experiments were begun in some associations. When the law was amended in 1956 to place the production credit associations under the credit banks, there was also an amendment permitting the banks to handle loans with up to five-year maturities. At that time we started an educational program and issued broad flexible policies. Within the scope of our general policy, each production credit association board of directors was to consider and adopt a specific policy for handling intermediate-term loans. The following general policy was issued by the bank and is still in operation:

"In making intermediate-term loans with maturities up to five years, there is an opportunity to render more complete credit service in the constructive interest of the farmer. It is recognized that adequate safeguards must be taken to protect the interests of the financing institution. Terms and conditions should he determined which are sound for both the borrower and the lender based on

the existing credit factors.

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"Generally, the principle should be followed that the longer the maturity the stronger the credit factors, due to the inherent risks and changes that may occur during the period the loan is outstanding. Repayment capacity should be adequate to repay annually the operating costs and recurring charges and provide a margin of profit which can orderly repay the capital credit extended on intermediate terms. The larger the loan and the longer the maturity, the more dependable should be the income and repayment. Every effort needs to be made to determine that the quality of the loan will not deteriorate while it is outstanding.

"The age of the borrower, continuity of operation, type of capital item, and the over-all quality of the farm operation financed will affect the decision as to the length of the maturity. Farm and financial management, tendency to create outside debts, and the ability to furnish all the short- and intermediate-term

credit required by the operation must be considered.

"The financial position becomes a more important factor. The total borrowings, short-, intermediate-, and long-term, should not be such that the debt load is excessive or that the intermediate-term loan would be excessive for the financial strength. Major split lines of credit should be avoided.

"Loans may be for eligible capital purposes or for the refinancing of current debts originally created for such capital purposes, where the borrower would be better served by a loan of longer maturity than annually. Emphasis should be given to the constructiveness of the purpose of a capital nature, particularly

as to the effect on the repayment capacity of the business.

"Collateral requirements should be consistent with the strength of the credit factors, and the loans may be made secured or unsecured. However, unsecured credit up to five years would be unusual and should be limited to those borrowers whose financial position is exceptionally strong and fully merits such terms over the period of the loan. The source of income must be stable and dependable to meet the installment payments as they mature. Secured loans should be supported with a pledge of collateral which will be adequate throughout the term of the loan, taking into account such factors as the rate of depreciation, obsolescence, and date of possible replacement.

"The repayment plan should provide for orderly liquidation of the intermediate-term credit which is in accord with the farmer's ability to repay. It should provide for annual payments which are commensurate with the depreciation of the collateral and the ability to repay. It must be understood that the entire line is expected to be repaid by maturity date. The understanding

with regard to unsecured credit must be definite and enforced."

I think this policy sets up the necessary safeguards to protect the production credit associations and still permits ample flexibility to extend any intermediate-term credit that can be justified by the credit factors. I

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further believe it is impractical to try to set up a complete list of loan purposes that might be handled on an intermediate-term basis and to designate the length of maturity or the exact amount of annual repay. ment requirements. I will try to illustrate more specifically how this policy works in the production credit associations on different types of farm operations.

Many farm units in our area are general purpose operations where hogs, cattle and crops are produced. This type farm requires financing for livestock, operating expenses, machinery and farm improvements. A very careful projection of all expenses and income is necessary before any decision is made as to the type of financing. Generally we would make an annual loan for the financing of livestock purchases and operating expenses and a separate loan on machinery purchases. If soil improvement, irrigation, or major building projects were undertaken, a third loan for five years could be made. The machinery loan would be secured by the equipment with an installment due annually. The installment would likely be written into the operating loan annually if income sources for payment were not otherwise available. On the five-year loan the security would depend on the credit factors and availability of personal property as collateral. In some cases a real estate lien would be taken as additional margin because of the extended maturity. The loan would probably be drawn on an annual installment basis with the installments to be written into the operating loan each year, provided outside sources of repayment were not available.

In our area cash crop farmers whose principle crops might be cotton, corn, or beans, generally require an operating loan and separate intermediate-term loans for capital needs. The operating loan would be set up on an annual maturity basis with crops and machinery as collateral, while the three year loan for capital purchases would be drawn on installments and would be supported by a chattel on the machinery purchased. If credit were required for purposes such as land improvements, buildings, or irrigation system, a five-year loan would likely be made with annual installments, secured by equipment or by a lien on the real estate. If all of the sources of repayment available were covered by the operating loan, the annual installments on the intermediate-term loans would be written into the operating loan each year.

We finance a substantial number of dairy operations in our district. In a strictly dairy farm setup, where practically the only source of income is from the monthly milk check, we have found that the annual maturity loans with payments made by milk assignment are generally acceptable to the dairyman and work best from the standpoint of the lender. An annual maturity loan permits any operating or yearly-recurring

expense to be calculated on a 12-month basis with capital credit for such purposes as purchase of cows, machinery, major repairs and minor improvements to be figured on a three year basis, and then any additional credit needed for a new barn or major improvements in the milk parlor to be spread over five years. One annual maturity note is drawn providing for repayment by assignment of milk income monthly for all annual operating and recurring expenses, one-third repayment of that portion of the capital credit to be spread over three years, and one-fifth repayment of the balance of the capital credit to be spread over five years. The balance remaining is then subject to renewal into the next annual loan. Another advantage to annual maturities on dairy operations is the fact that over three years many changes take place in a dairy herd and in collateral which necessitates rewriting legal papers.

However, our program is flexible and three separate loans might be made, one on an annual maturity, one on a three-year maturity, and one on a five-year maturity with the proper amount of monthly milk assignment from the dairy applied on each loan to liquidate by maturity. The decision would be made by choice of the farmer provided monthly income from milk and other credit factors were sufficiently strong to justify separate loans and longer maturities. In such cases, a second lien on the cattle and machinery might be taken as security on the second and third loans even though pledged as to the first loan, provided the collateral were adequate to safely secure the total line of credit. If not, a second lien on the real estate would be necessary. If the assignment of milk income cannot be obtained, then a monthly installment note is taken calling for the farmer to pay specified amounts each month to accomplish the same debt liquidating program.

There are also many dairy loans in our district where there is diversification and income is available from other than dairy sources, such as crops and livestock. In these cases we generally make separate loans: one on an annual basis with monthly payments from milk assignments and the dairy cows as security; another loan for major improvement items made on equipment and/or real estate to mature over a period of three to five years depending on the purpose. Under this plan we would draw the separate notes on an installment basis with repayment timed to coincide with income sources other than the dairy, such as the crop or cattle marketing season. Very definitely a flexible program is necessary in order

that it can be tailored to each case.

There are some serious problems involved in furnishing intermediateterm credit for the specialty operators such as broiler production and laying hen flocks. The broilers are mostly contract fed and generally there is very limited margin of income for the producer to pay capital debt.

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The feeding contracts are on an annual basis or might even be on the basis of one batch of poults. If the feed contract is not renewed, there is no source for repayment of capital credit. It is usually essential to take the real estate as security. Unless the farm operator is exceptionally strong financially and can assure repayment from other sources, we generally do not feel justified in making an intermediate-term loan. If we do finance the broiler operator we want to furnish all of the operating expenses, including the purchase of the broilers and the feed. Then we would make a separate loan for the capital items and tie repayment into the operating loan. If the capital item is for building or building improvements, then real estate is often required as secondary collateral. The laying hen operations are generally not under complete contract, There may be a contract to purchase feed and a separate contract to market eggs at a fixed price. We have had very good success in furnishing the operating and necessary capital credit on an installment note basis or on a pledge to apply all egg income monthly. These loans are drawn with maturities ranging from 30 to 36 months. Credit for buildings is generally drawn on a separate loan and most of these loans have maturities up to five years.

I hope my comments on these different types of farming operations will give you some idea of the flexibility required in an intermediate-term program. I considered the use of a specific loan example but decided against it because there are certain factors such as managerial ability, location to markets, type of land, etc., that have a definite bearing on whether or not the loan can be made. Just to report the fixed factors that can be shown on paper would be misleading. After all, sound extension of credit is a matter of complete analysis, trust, confidence, and understanding between the borrower and the lender. A full and complete understanding of the plans and agreement as to terms and conditions is essential. You can sell goods and require payment on fixed dates but if you lend constructively, I repeat, you must have a flexible plan that fits the farmer's program with repayment due at the time income from his

operation is available.

While we have been setting up intermediate-term loans for only a relatively short period of time, the program has been exceptionally well received by the farmers. Since the fall of 1956 we have made approximately 7,500 intermediate-term loans for \$25,000,000 and as of June 30, 1958, there are outstanding in the production credit associations in our district 6,000 loans for \$16,000,000. With the ever-increasing cost of capital items to improve and modernize today's farm, I look for 40 to 50 per cent of the outstanding credit extended by production credit associations to be in the field of intermediate-term financing. I firmly believe there is a real need today for a much closer working relationship between commercial

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businesses selling to the farmer and institutions financing the farmer in order that the sales made will be on a basis that will be mutually beneficial to the farmer and the commercial business. Farmers must modernize their operations and use improved methods to the best advantage but to do so they must also have a sound basis of credit to carry out this mechanization and modernization program.

There is a grave need for a closer working relationship between those trained in the field of farm management and those in the financing field, both of whom are trying to guide and help the farmer toward accomplishing necessary changes to improve his operation. I would like to tell you of one approach we have taken along this line. For several years we have been cooperating with one of the universities in our district in carrying out a series of meetings where county agents and production credit association field representatives meet to work out a feasible farm and financial plan. The meeting starts with the county agents explaining the processes essential to analyzing and preparing a farm management plan. Then the production credit association representatives explain the methods by which they arrive at a financial plan. The next step is a visit to a specific farm. In most cases the farm is one being financed by the production credit association and on which some plans had been worked out by the county agent. The farmer meets and advises with the group. The men pair off in teams of one county agent and one Production Credit association field representative. They consider the farm plan and the financial plan together. Then the teams meet and exchange notes on plans developed. This results in a much better over-all plan and one that the farmer can understand and carry out. We found that on many farms with proper management, we could soundly go a lot further in the extension of intermediate-term credit if improvements necessary to increase repayment capacity and the financial plans were coordinated. The studies also showed how capital items essential to the operation might be purchased at the proper time which permitted the credit institution to set up maturities and repayment in line with the best interest of the farmer. The program has been used with the university farm management group. I would like to see a similar approach with the supply dealers, both cooperative and commercial, marketing agencies, and others serving the farmer.

To summarize my ideas in the field of intermediate-term financing, I think there is generally too much feeling on the part of many that if financing institutions will just make intermediate-term loans it will save the farmers. This is not true. Many farm operations today are unsound and cannot be saved by just granting longer maturities on capital items. It will, however, provide a complete credit service needed by efficient farmers and sound operators, a service that can be planned so that his

debts will come due when income from his farm is available to repay them in an orderly manner and in line with sound financial practices. It can also be of material help to some farmers who are now operating unsound units when used for purposes that will increase the capacity to repay debts. If wisely used it will help in needed adjustment and expansion programs. It can be helpful in shifting from one enterprise that has become unprofitable to one that will be profitable and of adequate size. Many operators must double their cow herd, their hog enterprise, and must improve their soil if they are going to keep their program sound In our district only about 20 per cent of the intermediate-term loans are made for unit and soil improvement, while 80 per cent are made for machinery, equipment, and other labor saving devices. I hope there is some way in which this trend can be reversed. I would like to see a much greater percentage used to directly improve the capacity of the unit, A real educational program is needed. Management is essential. We have the capital, the facilities, and the resources in financial institutions all over the country by which intermediate-term credit can take its proper place in the farmer's program. However, I repeat, there is still need for much study, education, and understanding by all groups serving agriculture as to how the extension of maturities by intermediate-term credit can fit best into a sound financial program for the farmer.

# DISCUSSION: INTERMEDIATE-TERM CREDIT IN AGRICULTURE

NICHOLAS A. JAMBA National Bank and Trust Company of Norwich, N.Y.

There are so many things I would like to comment about insofar as intermediate-term credit for agriculture is concerned, and so little time allotted for that purpose. I hope I do not present an incomplete discussion and consequently what might appear to be a somewhat biased

opinion.

Morrow has presented an excellent review of agriculture's need for a type of credit that logically fits between seasonal, or short-term credit, and long-term, or mortgage credit. I probably was the wrong person selected to discuss his paper because had I had his assignment matched against my own experiences as a commercial banker for almost 20 years, I would not have been able to present to you a more complete and comprehensive picture of intermediate credit financing for farmers. His thinking, philosophy and experiences very much parallel those of progressive commercial banking.

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It is only logical to conclude that as new problems arise in agriculture as a result of the rapid changes in farm management, methods of financing agriculture must also change—and they are changing. Actually, it might even be somewhat of a moot question as to which change takes place first—methods of farming or changes in methods of credit granting—for the reason that in a modern dynamic agriculture one change is no longer possible without a change in agricultural finance so to make changes in methods possible on a commercial scale. What I mean to say is that as agriculture makes its progress based on technological improvements in the industry, progressive lenders anticipate such changes and the effects these changes in farming methods will have on their farm customers; they are prepared to adapt their lending procedures and repayment terms to suit the needs of agriculture as the new needs arise.

I know that some of you will not agree with me, but I want to stress the point that whichever lender leads in financing the credit needs of the agriculture of tomorrow, it must be aware continually of the operational adjustments taking place in the business of agriculture, and satisfy those tremendous demands of the agricultural industry for credit to finance its dynamic and rapid changes.

At this point I want to bring out the fact that the Farm Credit system, as described by Morrow, in spite of its excellent credit facilities and loan experiences, is not the primary source of intermediate-term farm credit today. As of July 1, 1957, the commercial banks in this country had outstanding four times the volume of non-real estate loans made to farmers than were outstanding in all the Production Credit associations. What portion of this great outstanding volume of credit in each case is intermediate-term credit is probably difficult to determine with accuracy for several reasons.

The point I want to make, however, and the point Morrow made so well, is this: Although there is no doubt that agriculture today has a real need for intermediate-term loans in its financial program, the Farm Credit system and commercial banks do recognize this need and are prepared and equipped to satisfy it. I do not believe that any part of agriculture's rapid changes are hampered in any way, in the case of the commercial farmer, by any defect in either the availability of such credit or in its basic administration. Except for relatively few limited small areas, I believe it is safe to make such statement.

Farmers today are under tremendous pressures because of the changes taking place in farming methods. I do not believe that even many people close to agriculture are completely aware of the effects these changes exert on management and the needs for modifications in lending tech-

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niques. Whether it is improvement in farm practices, better and more efficient equipment, improved seed, newer methods of disease control, better harvesting methods or whatever else, as soon as improvements in any of the factors of production are discovered, they provide progressive farm operators with extremely competitive advantages. This means that new pressures are then created by the good farmers and these influences then produce problems for all farmers.

Some people then feel that many of agriculture's new problems can be solved by new, or more flexible, or extended, or modified, or somehow changed credit terms or types of credit. In actual practice, lenders must comply pretty much with the principles of basic economics. Income is the only source from which loans—whether short-term, intermediate-term, or long-term—can be safely and soundly repaid without business liquidation. Banks and the Farm Credit system agencies have made loans to farmers for decades with repayment terms adjusted to coincide with loan purposes and income availability. Although some lenders have modified repayment terms on intermediate-term loans less rapidly than others, the purposes for which funds are borrowed generally dictate repayment terms.

Reasons why the mechanics of making intermediate-term loans change less rapidly than do repayment term adjustments was brought out by Morrow. There are greater inherent risks in loans in the longer maturities, and originally strong credit factors often deteriorate. I would like to add that the rapid changes made by management in a dynamic industry like agriculture indicate a need for conservatism on the part of lenders in this respect. I believe that a dependable source of credit to permit farmers to operate sound enterprises is far more important than the mechanics used by lenders to produce evidence of the debt. Commercial banks, for instance, are generally criticized because many intermediate-term loans are advanced to farmers on notes with maturities far short of the repayment terms extended with the loan. In many instances such criticism is justified and has resulted in improved changes in loan maturities. However, even with my long experience in financing farmers, I am not yet certain that "term" loans to agriculture should be adopted as standard practices. Many types of loans to farmers for a great variety of purposes can and should be made on a term-loan basis. On the other hand, a high percentage of operating loans made to farmers for a specified term need to be modified or adjusted several times before the original loan is repaid. Short loan maturities, with prearranged repayment terms adopted to anticipated income availability, usually permit greater flexibility in adjusting farm operations to changing conditions.

I would like to conclude my discussion with these brief predictions:

1. Agriculture has available today, and will continue to have available, an adequate supply of dependable intermediate-term credit to satisfy the needs of all commercial farmers.

2. Our dynamic agriculture's progress will not need to be predicated upon liberal and unsound or extended loan repayment terms.

3. The inability of a certain class of farmers to compete profitably within the industry will not be construed as a need for more liberal repayment terms or a special type of farm credit.

4. As the problems of a fast-moving agriculture become more complex, better farm managers, and not an availability of credit, will become agri-

culture's most critical need.

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5. The future needs for intermediate-term farm credit will continue to increase until this class of credit will begin to approach (in total outstanding volume) the amount of credit in use by farmers for current operating purposes.

## EFFECT OF URBAN AND INDUSTRIAL DEVELOPMENT ON AGRICULTURAL FINANCE

HOWARD G. DIESSLIN Farm Foundation

T LEAST two basic approaches could be taken on a paper under this title. The discussion might be confined to basic agricultural finance problems in the periphery of urban and industrial areas where the urban population is expanding into rural areas. This outward movement causes farm real estate values to rise due to competition for home and industrial sites. It creates problems of taxation. Should tax assessments be based on value of the property for agricultural purposes or for urban and industrial purposes. As these urban and industrial areas expand, farm people living in peripheral areas have increasing opportunities for nonfarm income The situation also creates need for financial and credit services for parttime farmers and others in such areas. The financial aspects of the rural development program, which is receiving increasing emphasis throughout the country, could also be considered.

On the other hand, a broader approach might be taken by considering the financial problems of American agriculture in the face of urban and industrial development. We have a tendency to look constantly at credit needs, the role of credit institutions, and other credit factors with reference to agriculture, both as a whole and by individual segments such as long-term, intermediate, and short-term credit. Each year the annual meeting is replete with detailed observations with reference to credit to improve agriculture. However, agricultural finance involves much more than agricultural credit. In addition, if we consider the effect of urban and industrial development on agricultural finance, this involves projecting trends and examining structural changes taking place in agriculture and the possible effect of these changes on financing in agriculture as we move forward.

Two recent research contributions by the National Bureau of Economic Research, entitled "Patterns of Farm Financial Structure" and "Capital in Agriculture: Its Formation and Financing Since 1870," give evidence of the great need to focus our attention on the over-all question of agricultural finance as contrasted with agricultural credit alone. The latter publication includes interesting and important findings with reference to the source of gross funds for replacement and additions to physical capital and working cash in agriculture.1 "Internal" financing, largely from gross

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<sup>&</sup>lt;sup>1</sup> Alvin S. Tostlebe, Capital in Agriculture: Its Formation and Financing Since 1870, National Bureau of Economic Research, New York: Princeton University Press, 1957.

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Since Press, farm income, was a major source of funds and exceeded 70 per cent in every decade except one since 1900. Even more significant is the increasing trend toward internal financing, which totaled over 90 per cent for the 1940-49 decade.

The great bulk of our teaching, research, and extension activities in the field of farm finance is directed to sources of funds, procedures, and techniques of agricultural lending institutions. Our attention has been concentrated on the external sources, which provide only 10 to 20 per cent of the total funds for maintaining and increasing the capital plant in agriculture. The findings of this study are sufficiently significant that we could well afford to re-evaluate our emphasis in the farm capital picture. Certainly, internal financing of the agricultural plant should receive greatly increased emphasis. In view of the weight of these substantial research contributions in recent years, I have chosen to take a broad look at the effect of urban and industrial development on agricultural finance in the commercial and noncommercial sectors of agriculture.

#### Commercial Farm Sector

The widespread application of new technologies and improved management to the commercial farm have tended to expand the size and scale of efficient operation very rapidly during the past few decades. The net result has been larger capital requirements per man and per farm along with greater division of labor, management, and ownership functions in the commercial farming operation. Commercial agriculture is beginning to show a greater tendency to produce for a market rather than just to produce goods. Integration of the agri-business structure in commercial agriculture is leading to increasingly complex financial problems. As this whole process moves forward the objective in commercial farming may soon become control rather than ownership of resources in agriculture. Certainly, financial management increasingly is the key to success or failure of the individual firm in commercial agriculture.

The net effect of the rapidly changing size and scale of the commercial farming operation has been to increase the difference in earning capacity of individual farms and operators in the commercial farming classification. As a more concrete example of this widening range in earning capacity, I would hazard this simple illustration:

## NET INCOME FOR A GIVEN "BUNDLE" OF LABOR, CAPITAL AND MANAGEMENT ON COMMERCIAL FARMS

	Upper One-third	Middle One-third	Lower One-third
1940	\$3.00	\$2.00	\$1.00
1958	\$5.00-6.00	\$2.00	\$ .5075

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The author here is speculating that the real net income to the "bundle" of resources has increased materially for the upper one-third of the commercial farms in the past 18 years, that it has changed little or none for the middle one-third, and that net earnings in real terms to those in the lower one-third has probably decreased. The difference in earning capacity has widened materially between the upper and lower third of commercial farms, in fact, even between the upper and middle third during a very short span of years. Along with this, we also recognize that the typical "bundle" of labor, capital, and management resources has shifted toward more management and capital and much less labor. I have estimated that the ratio changed from 3-2-1 to 5-2-3/4 during this period. I would not argue that the magnitude of the change in ratio is anywhere near correct, but I would argue that the direction of the change is correct. If this assumption is valid, important financial implications follow from the rapidly changing nature of the economic unit called the commercial farm.

As we view the financial structure of agriculture, we need to note the continued declining importance of farm real estate relative to other assets. Since 1940 alone, real estate has declined from approximately two-thirds of the total asset structure of agriculture to approximately 60 per cent of the total asset structure. The new agricultural technology has had a significant effect on land values in the aggregate during the past few decades. We can safely say it has held land values lower than would have been the case without the new technology. Technologies which are generally adaptable throughout agriculture, to say the least, have lowered the value of poor soil resources relative to the more productive soil resources in agriculture. The impact of technology on the agricultural economy will continue to be great. It seems only logical that land values will continue to be held in check by output expanding technologies in the foreseeable future.

Three conditions have been most favorable to application of the overall technology that has taken place to date with respect to crops. First, the more productive soils show the greatest response. Soil productivity in this respect includes texture, natural drainage, and other characteristics in addition to its native fertility, since more and more we are turning to plant food for providing the nutrients for crop growth. Second, topography adapted to farm mechanization is essential. Third, weather—both sufficient rainfall and proper distribution—remains important. This last factor, weather, will probably continue to become more important as new technologies are adopted in the years ahead. Irrigation currently gives no indication of becoming widespread throughout agriculture under presently known technology.

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nt as ently nder The gap in earning capacity between the areas well-adapted to technology and those not well-adapted will continue to widen. In general, land values in areas that are the most favorable in terms of the three conditions listed above—soils, topography, and weather—will continue to rise relative to areas with less favorable conditions.

In spite of the price depressing influence of technology on land values, farm real estate values have increased rapidly and continue to increase some. How much of this increase has resulted from changes in the general price level and how much from added capital improvements to real estate is difficult to discern. Capital improvements to land continue to add an increasingly higher percentage to the real estate value relative to the land itself. Some other factors in addition to a rising general price level which have contributed materially to rising real estate values in the past two or three decades include: (1) government support prices on farm commodities which have been capitalized into land values, (2) the low supply price of labor as it continues to migrate out of agriculture, (3) the scale economies in agriculture which are forcing intense competition for units available for sale, (4) considerably lower interest rates today as compared with those in the earlier part of the century, (5) some capitalization of new technologies into higher land values.

All available evidence tends to point toward a falling supply price for the services of farm land when stripped of structures and other improvements (buildings, tile, fertilizer, etc.). Along with this is growing evidence that continued application of technologies to land have made it a factor showing increasing returns rather than diminishing returns in the classical economic sense.2 The net effect is that land becomes a smaller and smaller factor in the over-all agricultural plant of American agriculture, both from the production and financial point of view. By constrast, the nonreal estate portion of the agricultural plant and of the typical commercial farm continues to comprise an increasingly larger share of the over-all financial structure. Purchased inputs, both operating and capital, are increasing as farms become more highly mechanized, as livestock becomes a more important enterprise in the farming operation, and as farm labor and home grown inputs are replaced. The increasing cash farm expenditures in relation to gross farm income over time makes this phenomenon readily apparent. As margins between cash expenditures and gross farm income continue to narrow, the need for enlarging size of business operation becomes more urgent, and the risk of price variability becomes greater. Many of these non-real estate assets, in fact, an

<sup>&</sup>lt;sup>2</sup>A detailed discussion of phenomena in agriculture was given by T. W. Schultz at the National Land Economics Institute, University of Illinois, in June, 1958.

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increasing per cent of them, are capital assets with a life much in excess

As we sum up the over-all structure of the commercial farm with reference to the past, we find that new technology in the form of machinery, improved seeds, commercial fertilizer, and farm mechanization among other developments, has proved to be a good substitute not only for labor but also for land. Thus, the supply price for both land and labor in agriculture has been declining for the past several decades.

Commercial farms have traditionally been owned by individuals; their financial structure is based on the internal capital of the operator and external capital sources in terms of landlord investments and credit. Certain types of agriculture are best adapted to landlord-tenant situations. These also are the types best adapted to the use of fairly substantial amounts of credit.3

As the spread in earning power between commercial farms at the upper and lower ends of the scale continues to widen, the question is what kind of differential financial structure is possible or economically sound for farms within the sector. In 1941, E. C. Young4 wrote:

"Through the use of credit the resources of agriculture are passed to those who have demonstrated their ability to use them. There is a kind of rule of thumb by which farmers have been guided in land purchase. It has generally been considered safe for a farmer to buy a farm when through his own earning power and thrift he has saved enough to make a one-third down payment on a farm. The loan experience of creditors will show that few farmers in this class have lost their farms or become chronic delinquents, the exception, of course, being those farmers who were seriously extended during the panics. When this process works smoothly, there probably is no better method for society to get the best farms into the hands of the best farmers and thereby insure the greatest economy in the use of resources. When the assets acquired through inheritance, marriage or speculation have served as a basis for credit, the social objectives of competitive credit may not have been realized. The banker's practice in the past of lending on the balance sheet has contributed to this social loss. When it is a matter of indifference to a creditor whether or not he forecloses, he may lend on the balance sheet with confidence. When foreclosures normally result in loss to the creditor, the practice of lending on eaming power, thrift, and morals is made profitable. The interests of society are best served when a loan is made on this basis. Even if the loan is properly made the farm may pass, while still encumbered, into the hands of poorly qualified owners through sale or inheritance."

Assuming this situation was true in the early 1940's, has not the widen-

E. G. Young, "Credit in Modern Agriculture," Journal of Farm Economics,

February, 1941, p. 53.

<sup>&</sup>lt;sup>3</sup> For an excellent discussion of this, see Donald C. Horton, Patterns of Farm Financial Structure, National Bureau of Economic Research, Princeton University Press, New York, 1957.

ing differential in earning power of commercial farms since that time made prospective earning power an even better basis for extension of credit as compared with the balance sheet? Perhaps a one-third down payment is not nearly sufficient on certain farms with limited capital and managerial ability, and it may be much too high on the upper one-third of our commercial farms. In what group of commercial farms will the landlord continue to be an important or perhaps an increasingly important part of the external financing structure? How can credit policies and procedures for commercial farms be made commensurate with their

earning power?

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The author's views on credit changes dictated by this changing structure of American agriculture can be found in other sources. However, with increasing size and commercialization of agriculture, we have now reached the point where a lending institution must be in a position to finance the entire farming operation, rather than just a portion of it. Specialized lending institutions which can finance only part of the farming operation are at a competitive disadvantage in the agricultural lending picture. There are many disadvantages to financing a farm operation through several institutions, and this situation generally results in more limited availability of credit than the farm operation warrants. More emphasis is needed on a balanced credit program for the individual farm. There is a real need for package credit to cover the entire farming operation. It can be provided best by financing the farm as a single unit of operation, and not by breaking it down into short, intermediate, and long-term segments.

Translating this into practical terms leaves several implications. For example, how long will insurance companies aggressively compete for a limited number of farm real estate mortgages in the commercial farming areas as they have done the past two decades? As the economy continues to grow, a smaller and smaller portion of their investment portifolio is in the agricultural sector. A specialized staff is necessary to solicit and to appraise the potential investment. Farm loans are small relative to some other types of investment. The cost of obtaining the investment is high relative to other investments, particularly where a specialized staff making farm loans only is maintained. Farms are not concentrated like urban homes, for example. In addition, the life insurance company can finance only the farm real estate, not the entire farming operation. This latter situation is not unique to insurance companies, of course; it is equally true of the Federal Land banks. Even so, I will not be too surprised if

<sup>&</sup>lt;sup>5</sup>See H. G. Diesslin, "A Re-examination of the Credit Needs of Agriculture, *Journal of Farm Economics*, December, p. 1200. Also see H. G. Diesslin, "Financing Modern Midwest Agriculture," North Central Regional Extension Publication No. 3, Purdue University, 1956.

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as many as one-half of the 15 or 20 major insurante companies making farm mortgage loans gradually drop out of the market in the years ahead,

#### Noncommercial Farm Sector

Under the preceding section we pointed out the widening differential in earning capacity within the commercial farm framework. The differential between the commercial and noncommercial farming sectors is even more striking. Thinking in terms of the part-time, residential, and low-income subsistence units in the noncommercial farm sector, a monetary comparison would be rather difficult to make. On the one hand, the bulk of the income of the commercial farm is from farming. On the other hand, a larger percentage of the income of the noncommercial sector comes from nonfarm sources. Whereas the differential between the commercial and noncommercial sectors was still not so distinct in the 1930's and early 1940's, I doubt seriously whether this is now true. Basically, the noncommercial sector of agriculture has been an owner-operator type of unit with a limted amount of credit available to it. What credit was available came primarily from individuals and local lending institutions, and the amount was based more on the balance sheet and moral characteristics of the borrower than the earning capacity of the farm resources. Here, too, the author is willing to hazard an example to illustrate the widening differential of farm earnings between the commercial and noncommercial sector.

## NET RETURNS TO A GIVEN "BUNDLE" OF LABOR, CAPITAL, AND MANAGEMENT IN AGRICULTURE

	Commercial Farms	Noncommercial Farms
1940	\$2.00	\$1.00
1958	\$2.50	\$ .25

In terms of real net returns to a given "bundle" of resources, I have speculated that the ratio between noncommercial and commercial agriculture has gone from 1:2 in the pre-World War II period to 1:9 at the present time. In addition, we take into account the fact that the volume of gross production per farm in the noncommercial sector traditionally has been extremely small as compared with the commercial segment.

#### Part-time and Residential Farms

Generally speaking, the part-time farm is a means of moving out of agriculture rather than into agriculture on a full-time basis. Over time, the nonfarm income becomes an increasingly bigger share of the total income of the part-time farmer. The part-time farm has critical financing problems, but these problems are not essentially farm credit or farm financing problems. In addition, as the importance of nonfarm income increases in relationship to the over-all income, farm income and the farm financing problem becomes much less important. The continual widening of the gap between the commercial and noncommercial sectors tends to make this less and less a farm credit problem. Financing, with any available credit base, must be increasingly based upon nonfarm income sources rather than farm income sources.

If the part-time farmer is going to be creditworthy from the farm or the nonfarm standpoint, we must look at the pattern of urban and industrial development to determine where opportunities exist. Areas of rapid urban and industrial development no doubt offer some credit potenital. Therefore, the financing problem of the part-time farmer, including the credit problem, is becoming more and more a problem to be answered in terms of the amount and variability of nonfarm income and the resale value of the property in question.

Little time needs to be spent with the question of the residential farmer. Here the financing problem and the credit base at the outset rests on the individual's financial situation and earning capacity in non-farm employment.

### Low-Income Farms

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Where a community offers little or no opportunity for outside income, serious financing problems exist. One of the problems is reorganizing existing agriculture into more efficient sized units and retaining the better operators on these units. Another problem is retraining and relocating the surplus workers in agriculture in nonfarm employment. Here, of course, the difficulties are numerous. The creditworthiness of the individuals usually is extremely marginal and the over-all problem is basically one of rehabilitation and welfare rather than agricultural finance.

In essence, this is a very complex financial problem. It cannot be "shrugged off" as an unrelated part of agricultural finance. Certain areas should go completely out of agriculture when viewed in strictly economic terms. Institutional and sociological considerations are at least as important as economic considerations. Grants and subsidies for redevelopment would be required for rapid progress. Though large amounts of capital are needed little credit would be forthcoming without substantial supervision and subsidy. Therefore, the financial problems involved in this

<sup>&</sup>lt;sup>6</sup>For an excellent discussion of the potential in local economic development and industrialization with particular reference to the noncommercial farming sector, see Vernon W. Ruttan, "The Potential in Rural Industrialization and Local Economic Development," Agricultural Adjustment Problems in a Growing Economy, Ames: Iowa State College Press, 1958.

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type of agriculture would warrant a separate and more detailed discussion than can be given in this paper.

#### Other Considerations

Many other financial considerations are important which have not been reviewed in relation to the title of this paper. These would include such items as the effects of federal, state, and local taxation on agriculture, farm owner-operatorship versus separation of ownership and operation, equitable farm leases in light of changing technology, retirement provisions for older farmers, getting established in farming, business and personal insurance programs for farmers, and estate planning. Time does not permit review of these important questions. As an illustration of how important some of them are, I would like to compare the personal and business insurance needs of commercial farmers with their current insurance practices.

A study of insurance programs of Indiana farmers revealed that only about one-fourth of the farm families studied had adequate types and amounts of insurance for satisfactory protection of their families and businesses. About one-half had insurance programs that were unbalanced and lacking in one or more of the important types of insurance. Some had adequate amounts of fire coverage but limited amounts of life and liability insurance or vice versa. Studies of insurance coverage of farmers of New York and Pennsylvania in recent years reveal very similar

situations.

The Indiana study indicated that the remaining one-fourth of the families studied either did not believe in the principles of insurance, preferred to gamble, or lacked funds to purchase insurance. Many carried the minimum amount of automobile liability insurance and had very inadequate fire and windstorm coverage on their real and personal property.

Generally speaking, farmers with sizable amounts of life insurance also carried most of the other types of insurance and those with no life insurance were generally lacking in their entire insurance program. The greatest shortcoming of the life insurance program was that less than 60 per cent of the families carried any at all. In addition, the average

coverage was low.

Farm families also appeared to have been over-insured in investment types of policies. Ordinary life and term policies would fulfill their protection needs just as adequately and at considerably less cost. If this situation were reversed so that farmers had 70 per cent of their life insurance in term and ordinary policies and only 30 per cent in the more

<sup>&</sup>lt;sup>7</sup> H. G. Diesslin and G. A. Quivey, "The Insurance Program of Indiana Farmers," Purdue Agricultural Experiment Station Bulletin 609, September, 1954.

 $_{\hbox{\scriptsize costly}}$  investment policies, much more adequate coverage could be purchased for the same dollar cost.

The need for more adequate insurance protection against the hazard of fire was clearly evident among Indiana farmers. The big problem in this area is that many farm operators need to reappraise building replacement costs and increase their insurance to more nearly cover possible losses. The same situation held with respect to liability insurance on property and vehicles. More and more farmers are carrying this type of insurance, but in a majority of the situations the total amount of coverage is very limited.

We now have fairly adequate knowledge of the coverage required for the personal and business side of agriculture. We are also beginning to do a better extension job of informing farmers what can be done with insurance. Two recent publications in New York illustrate needed and important information which can be supplied to farmers on these subjects.<sup>8</sup>

We now need studies and recommendations on the priorities than can and should be put on different types of insurance both from the business and personal standpoints. Types of insurance ordinarily included in an adequate insurance program are listed below. The kind of insurance considered most essential is listed at the top. Other kinds follow in a declining order of importance. However, it must be remembered that insurance needs vary with each farm and each farm family.

## Insurance Generally Considered High Priority for All Farmers:

- 1. Fire and extended coverage on real and personal property (probably two-thirds to three-fourths of current value).
- 2. Liability insurance

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- a. Auto, truck, and tractor if used on highway
- b. Farmers' comprehensive personal liability
- c. Workmen's compensation or employer's liability-if any hired labor
- 3. Sufficient term or ordinary life insurance to provide for
  - a. Payment of mortgage or other debts
  - Some income to the widow and family until they can adjust to new circumstances.

## Additional Insurance Usually Considered a Good Buy:

- 1. Medical payments and comprehensive coverage on automobiles, including collision on auto or truck unless over five or six years of age.
- 2. Certain types of medical and hospitalization insurance, depending on the cost and type of coverage.

<sup>&</sup>lt;sup>1</sup>See R. S. Smith and G. W. Hedlund, "Life Insurance for Farm Families," Cornell Extension Bulletin 1002, April, 1958, and R. S. Smith and J. R. Tabb, "Insurance in Farm Business," Cornell Extension Bulletin 1003, 1958.

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## Optional Insurance:

- 1. Health and accident insurance
- 2. Crop insurance-federal and private
- 3. Endowment and limited payment life insurance
- 4. Livestock insurance

These are tentative judgments of the author under certain circumstances. Certainly, in many farming situations much higher priority would be assigned to certain types of insurance given low priority here. Therefore, this is just one example of the many farm financial problems which require serious research and extension efforts.

## Summary and Conclusions

In looking rather broadly at the question of the over-all effect of urban and industrial development on agricultural finance, I have argued that agriculture has been an increasing-returns industry in the setting of just-past decades. Thus, agriculture has required reduced amounts of land and labor to produce an increasing amount of agricultural products. The application of rapidly expanding technology and added capital to agriculture to replace land and labor has tended to widen the difference in earning capacity of farms within the commercial farm sector and between the commercial and noncommercial farm sectors in the U. S. economy. Along with this there is, and probably will continue to be, a tendency for a falling supply price for agricultural land (as contrasted with urban real estate), since the relative importance of land in the overall agricultural plant is declining.

In reviewing the financial implications of the above situation, some of the conclusions we have drawn are as follows:

1. The earning capacity of the farm in question becomes the significant factor in determining the debt-carrying capacity of any given farm.

2. The debt-carrying capacity (from the standpoint of total asset structure) of the upper one-third of our commercial farms has increased materially during the past two decades, while the reverse situation holds for the lower one-third of our commercial farms.

3. With each passing year, the finance problem in the noncommercial farm sector becomes more and more a problem of financing a nonfarm rather than a farm enterprise.

4. The changing structure of the commercial farm makes it increasingly important that the farm be financed as a unit rather than in segments as has historically been true—i.e., real estate, working capital, operating capital, etc.

5. Specialized lending agencies will find it increasingly difficult to compete for an adequate volume of agricultural loans as agriculture continues

to become a smaller part of the over-all economy and the need for financing the whole farm operation continues to grow.

6. Other agricultural finance questions continue to grow in importance and will need to be given increasing attention.

# DISCUSSION: EFFECT OF URBAN AND INDUSTRIAL DEVELOPMENT ON AGRICULTURAL FINANCE

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PAUL R. POFFENBERGER University of Maryland

In recent years the American farmer has had an increasing need for more efficient management of his financial affairs than at any time in the past. This need has been accentuated by the advances in technology and the shift in use of resources. The management of capital is of primary concern to farmers as contrasted to the management of labor in the past. Therefore, Diesslin's broad approach to the problems of agricultural finance is logical. An analysis of the impact of urban and industrial development in agricultural finance brings the problems into sharper focus.

It is my general impression that Diesslin's paper adequately explains: (1) the trends toward commercial agriculture; (2) how technology has widened the spread in farm returns from different combinations of labor, capital and management, and depressed land values; and (3) the need for a revaluation of credit, as well as insurance, for a changing agriculture in the face of increasing agricultural integration.

It appears to me that the relationships between urban (including industrial) and rural economics, especially as they concern the financing of agricultural enterprises, might have been developed more fully. More attention should be given to the problems of financing private as well as public facilities and to production processes, particularly where urban developments create pressures on adjoining rural areas. In such cases there is the problem of obtaining capital or credit, both private and public, to provide housing, employment and living standards to a rapidly growing population. Likewise, in agricultural areas where farming or limited rural employment does not offer an opportunity to employ and support a growing population adequately, capital and credit must be made available to perpetuate such areas as well as provide the economic facilities in urban areas to which the rural population move.

The rather rapid rise in local and state governmental debts, and the limits on such debts, add to the problem. Moreover, since an increasing proportion of capital for agriculture involves non-real estate capital, and

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since there is a growing tendency to exempt personal property from tax rolls or to tax it at lower value levels than in the case of real estate, the burden of debt will fall more heavily upon real estate valuations. This situation is further intensified by the fact that the poorer potential agricultural areas, with usually smaller-sized farms, are the areas having the least proportion of non-real estate resources. Consequently, these areas will be hard pressed to finance the economic needs of their surplus population, and more hard pressed to help finance such needs for an influx of urban and industrial development.

Diesslin points out distinctive features in agricultural finance: internal versus external sources of financing. Changes in the proportions of these sources will obviously be determined somewhat by the extent of integration in agriculture in the near future. It may also be pointed out that integration will tend to limit financial requirements of farmers to fixed capital, while financing production processes will be a matter for industry and commerce. This should help toward the suggestion that the credit supplied to any one party could be more of a one package proposition. Another factor in this picture is the increasing number of commercial farms purchased by persons who do not need to borrow money to finance their transactions.

Perhaps the lack of understanding of financial management has been the greatest stimulus to integration in agriculture. Whether integration is good or bad for agriculture is not an issue of consideration here. However, the matter of financing the production of a commodity or commodities has been associated with integration. The broiler industry is a typical example. Generally, integration has developed where financial resources were available in the hands of a relatively small number of businessmen and the economic climate was such that the individual producer no longer wanted to assume the risk involved in operating independently. Thus, the producer is forfeiting his independence as an entrepreneur for the guarantee of a wage. This trend is rapidly developing in many areas.

It may be advisable to stress the increasing residual value of farms, especially in urban and industrial development areas, or where part-time farming prevails. This factor should alter the approach to credit for agricultural purposes.

Land may represent a smaller and smaller percentage of the total capital requirements of the agricultural plant, but I doubt the generalization that land will play a less and less important part in the national economic product because of the basic part which land and other natural resources have played, and will continue to play in the economic life of the nation.

In his conclusions, I believe Diesslin is implying that because of the changes in agriculture over the past several decades, namely the expansion in technology and the shift in the ratio of capital to land and labor, there is need for a thorough review of the whole field of agricultural finance. The emphasis on commercial farming is important in formulating a program of agricultural finance. Long-range policy can no longer logically be projected on the basis of averages, but rather the type of farm unit that will prevail 10 to 15 years hence should be given major consideration.

I was pleased to see the emphasis placed on a package proposition for financing the entire farm operation as a single unit instead of the traditional short-, intermediate- and long-term types of credit. More education

is needed in this area.

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otal lizaonal ural e of Another phase of agricultural financing that will need careful study is the capital structure of the farm operation and its relationship to the income producing capacity of the farm. This is the core of agricultural finance. The impact of financial management is basic to sound management decisions as ascertained by the farm budgeting method. I believe there is great need for integrating farm management and marketing decisions with the financing of agriculture. This approach is most applicable to the internal phases of agricultural finance which, in my judgment, will increase in importance.

The conclusions, although tentative and quite general, are significant in the over-all picture of agricultural finance. An appraisal of the effect of urban and industrial development on agricultural finance clearly focuses attention on the need for some major changes which have been

neglected too long.

### FEDERAL FINANCING OF RURAL UTILITIES\*

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E. C. WEITZELL Rural Electrification Administration, USDA

THE PROVISION of electric and telephone service to the rural areas of the United States has presented problems of financing for more than 50 years. The extent to which rural utility services are economically feasible has been a matter of continuing controversy. Demands for service have consistently been ahead of the availability of private capital to finance rural expansion. The comparatively higher costs of rural service and the lack of appreciation for the potential use of electric power and communication services by farmers sharply retarded early development. Many small companies, self-service organizations, and municipal systems developed to fill some of the demands.

The financing of most of the early rural telephone service was done by local subscription and small stock companies. Organizations were crudely established, few were incorporated, and little attention was given to long-term needs. Depreciation reserves, bookkeeping, and other requisites of good management were practically nonexistent. Although some educational assistance was offered by the U.S. Department of Agriculture, the depression of the 1930's, obsolescence, and the lack of maintenance led to the rapid deterioration of many rural telephone systems and farmer lines.

Central station rural electric service was slower to develop than rural telephony. Technical progress did not make long distance transmission and rural distribution of electric energy feasible until after the turn of the century. Except for irrigation pumping in certain localities and occasional rural industries, it was felt that farmers would use electricity only for lighting. Consumption was not expected to justify the cost.

Industry leaders apparently were prone to judge the potentials of rural service too much in terms of urban costs and returns. As has been noted in more recent years, they failed to anticipate the potential utilization of power on farms; they were too fearful of farm depressions that would ruin their investments, and construction standards were too rigid to permit lowering costs. As a result, the capital contributions required for the provision of service stymied any substantial expansion. Although a few small rural companies and cooperatives were organized, only minor progress was made toward farm electrification. The result was that only

<sup>\*</sup> The ideas expressed in this paper are the author's.

<sup>&</sup>lt;sup>1</sup> Farmers Bulletin No. 1245, Farmers Telephone Companies, Organization, Financing and Management, USDA, 1922 (Rev. Apr. 1930).

10.9 per cent of the nation's farms had central station electric service by 1935.

#### REA Is Established

On May 11, 1935, the Rural Electrification Administration (REA) was established by executive order, as an independent agency, under the Emergency Relief Appropriation act of 1935. Under this act, \$100 million was made available for rural electrification activities.2

Even before the order was signed, conferences with industry representatives were begun because it was recognized that the program should have the full cooperation of the operating power companies. In fact, it was hoped that generous loan terms would encourage the power companies to use federal funds for constructing rural electric facilities. It was also immediately recognized that there was little possibility of employing any substantial amount of relief labor in developing an industry requiring so many skills. This strengthened the concept of a loan program as the best modus operandi for putting the available funds to work.3

The initial cooperation of the electric industry gradually depreciated into general opposition. Many reasons for this change in attitude have been given, but only slight progress was made during the first year of REA, except to lay the groundwork for the future. Farm organizations and congressional interests were aroused to take more positive steps. On May 20, 1936, the Congress re-established REA under the Rural Electrification act, as a 10 year program for the purpose of lending funds "to persons, corporations, states, territories, and subdivisions and agencies thereof, municipalities, peoples utility districts, and cooperative, nonprofit, or limited dividend associations . . ." to construct rural electric systems.4 In making loans the act provided that the administrator "shall give preference to states, territories, and subdivisions and agencies thereof, municipalities, peoples utility districts, and cooperative, nonprofit or limited dividend associations, . . . "

By this time REA officials apparently recognized that the program would be carried on primarily by rural electric cooperatives and similar nonprofit organizations. An intensive program was launched by REA to assist in the organizing and financing of rural electric cooperatives and public utility districts throughout 45 states. There was no prohibition against commercial applicants, but the enthusiasm of farm groups for the "cooperative pattern" overshadowed minor interests by other types of applicants.

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<sup>&</sup>lt;sup>2</sup>H. S. Person, The Rural Electrification Administration in Perspective, Agricultural History, Vol. 24, April 1950, p. 70.

<sup>\*</sup> Ibid., p. 73. 'Ibid., pp. 74, 75.

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The REA was established as an independent agency of the federal government. It has been a loan program from the beginning without any direct grants-in-aid or subsidies. Effective July 1, 1939, REA was transferred to the department of agriculture, under Reorganization Plan II.

The initial act provided that loans should be made for a maximum of 25 years' duration,

". . . at a rate of interest equal to the average rate of interest payable by the United States of America on its obligations, having a maturity of 10 or more years after the dates thereof, issued during the last preceding fiscal year in which any such obligations were issued." 6

Except for \$13,928,288 obtained under the Emergency Relief Appropriation act of 1935, and \$130 million obtained by direct appropriation of Congress, loan funds were borrowed from the Reconstruction Finance Corporation (RFC) at a rate of 3 per cent. In contrast, the rates charged borrowers in accordance with the above formula varied from .03 to .0246 during the period 1936 to 1944.

The agency operated in this manner until the Pace act of 1944.7 Under this amendment the rate of interest was established at 2 per cent, the maximum amortization period was extended to 35 years, and the 10 year program limitation was removed. In 1947, the source of funds was shifted from RFC to the treasury. Congress annually authorizes certain amounts that REA may lend to its borrowers. In turn, these funds are borrowed from the treasury under an agreement between the REA and the secretary of the treasury.

The principal purpose of REA loans must be to provide electric or telephone service to persons in rural areas. In turn, rural areas are defined as those areas outside of towns and cities of 1,500 population and over. Where it is necessary and practical to integrate rural areas with towns of more than 1,500 population, telephone loans may include funds for such towns where this is requisite to the extension of service in rural areas.

Electric loans to cooperative and other nonprofit borrowers normally have been "100 per cent" loans in that they have not been required to provide equity capital. Loans usually include funds for completely financing the organization and development of rural electric cooperatives. One of the early guidelines of the REA program was that of "area coverage" service—e.g., service to all potential consumers within practical limits at a common rate, and without contributions in aid of construction.

Two principal types of electrification loans are available. "Section 4"

<sup>&</sup>lt;sup>8</sup> 4 Fed. Reg. 2732

<sup>6 49</sup> Stat. 1365 (1936).

<sup>&</sup>lt;sup>7</sup> 58 Stat. 739 (1944) U. S. Code, Sec. 904 (1952).

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loans are made for the over-all purpose of providing central station electric service to rural areas, including all phases of distribution, generation and transmission. "Section 5" loans are made to existing distribution-type borrowers for reloan to electric consumers for financing the purchase and installation of wiring, appliances and equipment. Consumer facility loans are made on a 5-year basis, at the same 2 per cent rate of interest as all other REA loans. Borrowers establish the interest rate on the funds reloaned to consumers.

A long-standing policy of REA has been to make generation and transmission loans only where power is not available from other sources or where a savings in the cost of power can be realized. Although some loans for generation and transmission have been made directly to distribution cooperatives, larger "G & T" loans have usually been made to federated groups of distribution systems.

## Rural Telephone Program

Following World War II interest grew in extending and improving rural telephone service. The independent telephone industry of some 6,000 small companies and thousands of farmer lines generally had consumed their meager capital through obsolescence and the failure to lay aside reserves for depreciation and replacement. The depression, followed by the lack of line materials and equipment during the war, intensified the rapidly deteriorating conditions of rural telephone service. It was frequently pointed out by farm organization leaders and others that the 31.8 per cent of farms (as shown by the census) having telephones in 1945 was lower than that of 1920 (38.7). And in much of the country the grounded megneto service had deteriorated because of lack of maintenance and the increase of transmission interference resulting from rapidly expanding rural electric lines.

Again, much of the operating industry strongly opposed congressional proposals to establish a financing program for rural telephony similar to that for rural electrification. Existing commercial interests were fearful lest a full-scale "cooperative-type" promotional program be the result. Without being too vocal in behalf of any particular remedy, many of the smaller independent companies agreed to one point: a suitable source of long-term financing was requisite to any substantial improvement in rural telephony.

In October of 1949, Congress agreed with this point of view and enacted H. R. 2960,<sup>8</sup> amending the Rural Electrification act of 1936, to provide a rural telephone loan program. In many respects the new program resembled the electrification program. It provided the same 2 per cent interest rate and the 35 year maximum loan term.

<sup>63</sup> Stat. 948 (1949); 7 U. S. Code, Sec. 920 (1952).

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It was "declared to be the policy of the Congress that adequate telephone service be made generally available in rural areas through the improvement and expansion of existing telephone facilities and the construction and operation of such additional facilities as are required to assure the availability of adequate telephone service to the widest practicable number of rural users of such service."

The act provides that "the administrator is authorized and empowered to make loans to persons now providing, or who may hereafter provide, telephone service in rural areas, and to cooperative, nonprofit, limited-dividend or mutual associations." It is of interest to note that the language of this section and the congressional history of the amendment set forth a clear preference in the making of loans to existing systems already providing service in rural areas, with no provision for loans to public bodies such as state and local subdivisions or public utility districts. This preference to existing commercial and nonprofit telephone enterprises was strengthened by a further requirement that applications from such systems be considered and acted upon for a period of one year before applications from others for serving the same or similar areas are acted upon.

Loans may be made "for the purpose of financing the improvement, expansion, construction, acquisition, and operation of telephone lines, facilities or systems to furnish and improve telephone service in rural areas." The administrator in making such loans must determine that the service to be provided or improved thereby will be made available to the widest practicable number of rural users. He must also determine and certify that in his judgment the security therefore is reasonably adequate and that the loan will be repaid within the time agreed.

Funds may be provided for refinancing existing debt up to 40 per cent of any loan, and funds may be made available for the other stipulated purposes without limit so long as the loans are found to be economically feasible. Refinancing is not possible merely for the purpose of obtaining a lower rate of interest or a longer amortization period. Likewise, funds for the acquisition of other telephone properties may be included in loans only where such acquisitions can be shown to contribute to the improvement and extension of rural service.

Normally, principal payments are scheduled to begin three to five years following the date of any note under which funds are advanced. Thereafter, debt service is billed in equal quarterly installments throughout the remaining life of the loan. Interest payments accrue and become payable quarterly on the basis of the funds advanced to borrowers.

As security for its loans, REA requires a first mortgage or the equivalent thereof. The loan contract and mortgage entered into by borrowers in-

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clude the usual requirements found in long-term contracts and indentures. Loan funds are placed under note and advanced to borrowers as needed to meet obligations incurred for the approved purposes. The advance of funds is made only after all regulatory requirements, title clearance, and other loan contract requirements are met. Proper accounting must be followed and adequate reserves for depreciation, maintenance and other utility purposes must be provided. Borrowers must agree to minimum construction standards; provide REA with quarterly and annual operating reports and annual CPA audits; meet minimum insurance requirements; establish adequate rates and other charges; provide satisfactory management; and maintain the facilities financed with REA funds in an acceptable manner.

In the early years, commercial telephone borrowers were asked to provide from 20 to 30 per cent equity in new capital or in existing net worth. Later, this standard was reduced to 10 per cent. Cooperative and other nonprofit-type borrowers were required to provide equity capital supplementary to loan funds in the amount of \$50 for each new subscriber to be served, and \$25 for existing subscribers, on facilities already owned or acquired.

Owing to the difficulty of getting rural people to contribute capital as a requisite to the provision of telephone service, and the time and cost consumed in obtaining and meeting them, even these minimum requirements were canceled in 1957. In eliminating the nominal equity requirements, REA substituted more stringent mortgage controls in the interest of loan security. Currently, equity is required only where acquisitions exceed REA appraised values, in those instances where subsidiary corporations are formed by property transfer to take advantage of REA financing, and in other instances where deemed requisite to loan security.

The REA approach to the financing of rural utilities is more than a credit program. Financing is basic, but the provision of technical assistance during the early formative years of a rural electric or telephone system has been fundamental to the success of the program. REA has carried out an intensive program of research activities, in cooperation with manufacturers, to find ways and means of reducing costs and of designing electric and telephone systems to meet the needs of rural areas. Technical assistance, provided through a field force of specialists in engineering, accounting, and the various phases of operation and management has been a continuous part of the REA pattern. REA assistance is provided until borrowers establish an acceptable loan security position.

The same approach has been followed in the development of rural telephone financing. Many of the existing telephone companies and co-operatives had failed to adopt adequate accounting practices, had failed

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to maintain their plants, and generally, had allowed their small enterprises to deteriorate to the point that they now had to build from the ground up. They also needed improved management just as they needed new physical plants.

## Progress and Achievements

One index to the progress under the rural electrification program is the growth in the percentage of farms electrified—from 10.9 per cent in 1935, to 94.8 per cent in 1957. In addition to the farms that received central station power during this period other rural residences and business establishments of every type have realized the vast benefits which were formerly available only to urban residents. The REA loan program has been responsible for only a portion of this progress, with REA borrowers estimated to be serving about 54 per cent of the nation's electrified farms. Under the spur of federal financing, many commercial companies inaugurated active rural extension programs of their own.

To carry out the REA program of rural electrification credit during the past 22 years, Congress has authorized funds in the amount of \$3,855,928,000 through fiscal year 1958. REA has approved loans in the amount of \$3.7 billion, and slightly more than \$3.1 billion has been advanced to borrowers. Approximately 78 per cent of the total loans has been for distribution facilities, while 21 per cent has been for generation and transmission. Only 1 per cent has gone for consumer-facility loans.

Loans have been made to 980 cooperatives, 49 public power districts, 27 other public agencies, and 24 commercial companies. Distribution-type loans, totaling \$2.8 billion, have been made to construct 1,471,506 miles of line and other facilities to serve 5,013,405 consumers. A total of 41 generation and transmission cooperatives have received loans in the amount of \$578 million. Borrowers are located in 45 states, Alaska and Puerto Rico.

By the end of March, 1958, borrowers had repaid a total of more than \$525 million of the principal amount borrowed and had paid some \$317 million in interest. On the same date, the total delinquency amounted to less than \$131,000, and this was owed by only five of the 984 active borrowers. Actual losses have occurred in only two cases—totaling less than \$38,000.

The achievements of the rural electrification financing program can best be measured in terms of what it has brought to rural living, farming and rural industry. The consumption of electric power on farms increased from practically nothing, prior to 1935, to an over-all average of approximately 290 kilowatt hours in 1957.

In terms of human welfare perhaps the most noteworthy accomplishment was the elimination of drudgery in the farm home and on the farm-

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hmstead. Antiquated methods of pumping water, handling grain, milking, laundering, and the many other laborious aspects of rural living have been eliminated. Modern electrical, plumbing and sanitary facilities have been installed in their place.

During the first eight years of the rural telephone program, approximately \$475 million have been loaned to 610 borrowers. Approximately two-thirds of the borrowers are commercial companies, and the remainder are cooperatives or similar forms of nonprofit enterprises.

Telephone loans to date have been made to borrowers who are serving and planning to serve more than one million subscribers over 275,000 route-miles of line. Of these subscribers, approximately 547,000 will obtain improved and expanded service as a result of REA loans, while 453,000 will be given service for the first time.

Although REA borrowers are young in terms of financial history and development, their record to date is comparable to that of the electric borrowers. Only 17 are delinquent in debt service payments more than 30 days, and most of these are making substantial progress toward eliminating their delinquency.

The latest estimates of the U.S. Department of Agriculture indicate that approximately 55.3 per cent of the farms in the United States have telephone service. However, less than 34 per cent have dial service. If we assume a potiential saturation of 75 to 80 per cent, this means that a tremendous job of rural telephony remains to be done. Rough estimates indicate that the provision of reasonably adequate telephone service to the rural areas of the nation will require more than \$2.25 billion of new capital, exclusive of defense installations and civil aeronautics communications services that may be required.

The extent to which the REA program will or should be responsible for the completion of this vast rural telephone job depends on the extent to which private capital finds it feasible. Many of the larger telephone companies will undoubtedly continue to expand and modernize the more profitable rural areas surrounding the towns and cities which they serve. However, several thousand single exchange companies and farmer lines remain to be consolidated and merged into efficient operating units. Except for occasional additions to larger companies, the expansion and modernization of most of these will likely depend on low-cost public financing. The inability of many larger independent companies to secure enough equity capital to qualify for conventional private financing, coupled with an apparent shortage of long-term financing for small businesses in general, means that they also will continue to require public financing to do an adequate job of rural telephony.

### Current Pros and Cons

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Appraisals of the REA programs have varied from extreme to extreme. On the positive side, the rural electric and telephone programs have been lauded as the most valuable contributions to the United States economy since public education and public roads. On the other side, "socialism, unfair competition," and similar labels have been attached to REA by its opponents. A fear has often been voiced that extensive government credit will eventually lead to government ownership of the utility industry.

Time and experience, however, have mellowed much of the early opposition to both electric and telephone programs. The growing willingness of the independent telephone industry to accept the loan program and to assume responsibility for rural telephony indicate that the fear of government is disappearing.

With the basic job of extending electric power to the nation's farms nearing the 95 per cent mark, REA loans for financing distribution facilities are generally taken for granted. Section 5, or consumer facility loans, have never been made in sufficient volume to create substantial opposition, especially where borrowers' power utilization and sales promotion programs have been carried out in cooperation with local merchants and suppliers.

The contributions that adequate power and communication services make to rural living, and the economy as a whole, are more and more generally recognized. In addition to the direct benefits of power utilization in agriculture, it is estimated that for every dollar invested in rural electrification systems, approximately \$4.00 is spent by the consumer for initial wiring, fixtures, appliances and equipment. Thus, the market created for electrical appliances and equipment by the investment of nearly \$3 billion of REA loan funds has been substantial.

Current criticism of the electric program frequently centers around the continuing amounts being loaned to the rural electric cooperatives. Commercial interests continue to be apprehensive, especially about borrowers' efforts to provide their own generation and transmission facilities, rather than to purchase power from commercial sources. They feel that expansion of this type is an unnecessary use of low-cut government credit, and unfair competition since they claim the willingness and ability to provide adequate power supplies.

It is frequently suggested that the REA electric loan program should be discontinued now that practically all rural areas have been served. On the other hand, public utility financing is not a one-time proposition. The need for financing will continue as long as system capacity must be increased to meet the continuing growth in power consumption.

Another point of criticism derives from the nearly \$600 million in funds that have been loaned but not advanced to the rural electric cooperatives. REA loans normally have been made on the basis of borrowers' projected needs for meeting borrowers' future service requirements. This has resulted in the accumulation of funds which may not be drawn by borrowers for several years.

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Critics also observe that loans continue to be made to borrowers who have substantial cash accumulations. This criticism is intensified by the observations that borrowers use low-cost public money for capital additions while investing their surplus and reserve funds in higher yielding securities. Although the question of propriety may appear strong in this connection, borrowers justify it on the basis of need for maintaining adequate reserve resources for financing plant replacements and for emergency use.

Recent proposals to the Congress would raise the interest rate to equal the cost of long-term federal borrowing plus an additional allowance to cover the costs of administering the programs. It also has been proposed that many borrowers are able to afford conventional credit terms and that they should be shifted from public to private sources of borrowing through insured commercial loans or a pooling of private and public funds.

Opposition to changes of this nature covers a wide range of reasoning and emotions. On the one hand, it is said that these proposals lose sight of the objective of the program—e.g. to provide "area coverage" rural utility services which are not attainable through any other means, except grants-in-aid, or total subsidy. The more extreme reaction is that such proposals are designed to destroy the REA program.

Although the average cost of federal borrowing has been above the 2 per cent interest charged on REA loans since 1951, opponents to a change take the position that the cost of money is only incidental to the aim of the program. They point out that higher interest rates would discourage further extension of service to marginal and sparsely populated areas, and would result in higher service rates to rural consumers and subscribers.

The significance of an increase in interest rates depends on the amount. Even a moderate increase of 1.0 or 1.5 per cent might deter some marginal rural utility development in both electric and telephone programs. The extent to which a rate equivalent to the average cost of federal borrowings would affect the program may readily be overemphasized. Because of the relatively lesser extent to which the job of extending and modernizing rural telephony has been completed and because of the narrow margins of economic feasibility characterizing many rural tele-

phone operations, an increase in interest rates may have a more adverse effect on the telephone program.

A possibility of reducing over-all debt service costs would be to refund a portion of the loan at the end of a specified period. This practice is generally followed in commercial utility financing. Such a modification in current REA practice may have a more favorable effect on the ability of borrowers to serve marginal areas than is represented by the difference between the cost of money and the 2 per cent interest rate.

A prominent farm organization leader recently suggested that the REA program might be reconstituted in a form similar to that of the Farm Credit Administration and the Land banks.<sup>9</sup> This idea may appeal to many borrowers, as a means of establishing the REA program on a permanent basis. An initial sharing of low-cost federal capital with member deposits might answer a number of bothersome questions.

It might provide an acceptable depository and use for member surplus and reserve funds, and make it possible to establish a borrower-owned source of future credit. By the use of borrower deposits and the sale of securities, the use of public funds might eventually be curtailed and gradually eliminated, without sacrificing the basic objectives of the program. The fact remains that any increase in the cost of credit will lessen the extent to which rural utility services can be provided to the more marginal areas at a reasonable cost.

Borrowers may decide that the long-term uncertainties of interest rates, availability, and loan restrictions warrant some type of change. This, or any similar change, would involve many ramifications that cannot even be mentioned in a brief article. The relationship of past and future loans, the manner in which public and borrower funds would be shared, the degree of dependence on the availability of funds from the private money market, and the protection given to borrowers' interests are only a few of the many considerations and implications involved.

Throughout the 23 years of REA, many pros and cons have been advanced concerning this federal credit program. These will probably continue because of the many varied interests concerned. One fact stands out: substantial progress has been made by the respective interests in getting central station electric service to 95 per cent of the farms and modern telephone service to an increasing number of rural families.

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<sup>&</sup>lt;sup>o</sup> Charles B. Shuman, The Nation's Agriculture, March 1958, p. 6.

#### DISCUSSION: FEDERAL FINANCING OF RURAL UTILITIES

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Weitzell has made a commendable effort in portraying the multivariate historical, institutional and economic interrelationships underlying developments in the financing of rural utilities. His paper provides a good background for understanding the economic and political environment within which we operate today. His treatment of the role of the REA in the U.S., its motives and aims, are excellent.

The limitation of the paper lies not in what is said, but in what is left unsaid-not in the logic employed, but in the implicit assumptions underninning this rationale. Although the author recognizes that the "extent to which rural utility services are economically feasible has been a matter of continuing controversy," he neatly avoids what seems to me to be the real issues of the controversy by assuming that the role played by government in the past is the most desirable and only acceptable role. I am not sure that this is the case and sincerely wish that an individual such as Weitzell, with his broad knowledge of both economics and public utility operation, would have tackled the job thoroughly. By way of illustration, I am not convinced that financing rural utility service is so strictly a matter of economic feasibility in the normal sense of the word. In a modern society we do not necessarily expect every individual to bear the total costs of certain minimum services and comforts. Classic among these is hospital service, RFD, and public education for all children. Perhaps the provision of electric and phone service with its many conveniences and contributions to health and welfare is amenable to the same kind of rationale. I wish that the author had set his sights higher and speculated on what would be required of government to provide telephones and similar services for specific levels of saturation. Then, let us discuss and John Q. Public decide whether we want to do it or not.

I generally agree that the provision of electric services is "well out of the forest," but many problem areas still exist. The great intermountain west faces problems as severe today as those faced in the corn belt in 1935. Just because we have made progress is no reason for resting on the job.

The telephone program obviously has a lot of tough sledding ahead. New areas which need to be serviced with both phones or electricity are those with narrow economic margins. Even loans for 38 years at 2 per cent interest do not make some projects look feasible. With this kind of situation I wish the author would have discussed the possibility of some bold new approaches.

What about public service commissioners requiring utilities operating in a given area to really provide "area coverage"? Reports by utility off. cials before public service commissions concerning the addition of sparsely settled areas give me the impression their economists have done a poor job of teaching the marginal concept to company officers If sparsely populated areas had only to bear the costs added to a going firm by their addition, the charges for service might not be as high as is frequently requested. If present firms will not provide "area coverage." would it be too wrong to ask them to give up their franchise in areas of greater subscriber density and the area be given to someone willing to serve it? I can already hear the howl, "unfair;" however, I want to point out in advance that no two subscribers to a public utility carry an equal burden of financing or contribute equally to the profit till. The extent to which discrimination is permitted is a matter of acceptable norm as it relates to the granting of the franchise and establishment of rates, Perhaps the norm needs to be changed.

I agree that the success of the telephone program and further extension of electric service depends to a large extent on the continuation of low cost public financing. However, it is conceivable that adjusting interest rates to conform to the cost of long-term federal borrowing on loans advanced for expansion of plant and introduction of technological improvements would not appreciably endanger their implementation. I wish that the author would have commented on the effect differential interest rates based on use would have on the industry. Differential rates

are commonplace in other industries.

Several alternatives need to be thrown into the hopper for appraisal and discussion. Some may be more effective than what we are doing at present and involve less cost. I wish the author would have discussed the following, giving us the benefit of his experience in the public utility field:

1. What would a positive, aggressive encouragement of the fusion or merger of electric and/or phone cooperatives accomplish? How large, if any, are the economies associated with organization, administration, management, and acquisition of capital? We need to be exposed to the judgment of a reliable, well-informed individual who has a working

knowledge of the public utility field.

2. The utilization of publicly supplied capital could be discouraged and use of private capital encouraged on the part of organizations with a reasonably strong reserve position and thus have access to private capital markets by exempting them from paying corporate income taxes on earnings derived on newly added investments to expand into marginal areas and/or exempting interest on their bonds from federal, state and municipal tax levies. Although it is obvious that there would still be a public

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cussi list utili "cost" involved, in light of political psychology such a program might be more readily accepted than those involving the use of tax dollars.

3. A government guarantee of loans made by institutional lenders such as Weitzell suggested in the latter part of his paper might be an effective means of channeling private funds into going concerns for expansion or

capital improvement.

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4. Consideration should be given to the development of specific criteria for the determination of eligibility for less than cost to government financing. Some indication of the extent of marginality of service, such as consumer-per-mile or the proportion of farm to nonfarm customers, would

be logical variables in the formula.

5. The proposal concerning the possibility of reorganizing the REA on a permanent basis patterned after the FCA seems worthy of consideration. This is an excellent idea, provided we are content to advance on a 100 per cent economically feasible basis. It is inconceivable that such an organization would continue to press out into the marginal areas and expand services rendered. Many students of the FCA are concerned about the inherent conservatism of lending policies of farmer owned and controlled organizations. I have long been a supporter of cooperative credit; however, it is not a "cure-all." It cannot be expected to provide noneconomic or even close to marginal services. If this route is followed, some kind of public agency must still exist if we are to continue to provide service to higher percentages of our rural people.

I would suggest that a substantial share of what we are now doing through the REA might be turned over to the banks for cooperatives and a reorganized type of REA work on the sub-marginal area in much the way FHA works for farmers. Just as soon as an organization is a sound financial risk in a normal lending sense, the loan should probably be

transferred.

6. Could some device be found by which risk of expansion into marginal or sub-marginal areas by a going concern would be lessened? At the present time many REA cooperatives could expand into marginal areas with the hope of neither gain nor loss. They are not doing it because to do so would risk the capital equity of present members. Risk is the big cost involved in expanding into sparse areas. Many areas could be served by going firms if financial risk to present owners, whether cooperative or otherwise, could be reduced, underwritten, or limited to small amounts. Such a program would likely cost the taxpayer very little.

Weitzell raised more questions than he answered. I am sure this discussion has not answered any questions and has probably added to the list of unanswered. Economists have long neglected the rural public

utility field. I am glad to see a rebirth of interest.

#### FARM SUPPLY MARKETS

Chairman: B. N. Arneson, Department of Co-operation, Saskatchewan

# THE CHANGING STRUCTURE OF MARKETS FOR FARM MACHINERY

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THE INFLUENCES which have determined the structure of the farm machinery market can be grouped under three headings: physical factors, primarily those related to the geographical features of the agricultural market; technological factors, including those characteristics of farm machinery which have led to the production and marketing of "full lines" by the leading manufacturers; and financial factors, those relating to the difficult problem of financing farm machinery sales. This paper is an attempt to show the leading characteristics of the market structure as it developed prior to World War II, and to indicate changes which have been taking place since then.

#### The Background: Before World War II

The leading physical features of the market for farm machinery have always been lack of concentration and diversity of conditions among market areas. It is a market made up of a tremendous number of relatively small enterprises scattered over a vast rural expanse. Diversity results both from the varying requirements of soil and terrain, and from unpredictable variations in farm income among areas resulting from local crop conditions. Taken together, these characteristics of the market explain the key features of the distributive structure which developed early in this century. They explain the need for decentralization and flexibility in response to which the leading producers developed the branch-house method of wholesale distribution. They explain the urgency, from the producer's point of view, of being represented in every segment of the market, and the consequent building up, in the early decades of this century, of a large and unwieldy organization for retail distribution.

Technological factors made a further contribution to excess distributive capacity. Significant developments in harvesting machinery in the nineteenth century preceded by a number of decades of comparable developments in tillage machinery, and the producers of these two major types of equipment developed as two quite distinct industries. Eventually, the costliness of maintaining year-round distributive organizations for the marketing of single, highly-seasonal lines provided the needed impetus to merge. By the turn of the century such mergers were common, and the

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trend toward the full-line firm had begun. By the middle 1920's, the development of the farm tractor as the power source for machinery, and the gradual centralization of farm tractor production within the implement industry, had brought the trend to completion.

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Pressures of competition led the early full-line producers to show decided preference for exclusive dealing arrangements. As a result of this pratice and of the apparent need for representation in every corner of the market, there developed the pattern, not unfamiliar even today, of clusters of full-line retail dealers pinpointed over the market area. By 1937 and 1938, the industry was coming under sharp censure from official sources in the United States and Canada on the subject of its distributive practices. The Federal Trade Commission (FTC) pointed out after an exhaustive investigation that "the most frequent criticism voiced by dealers respecting their relations with manufacturers was that manufacturers have set up too many dealers." A Canadian parliamentary committee reported that "unless some outside agency or competition forces them to do so, it is unlikely that the companies themselves will initiate a more economical policy, as each fears the loss of identity of its own organization."

Excessive distributive capacity necessitated the carrying of abnormally heavy inventory and intensified the problem of financing farm equipment from the factory to the user.

The problem of credit in farm machinery sales is as old as the industry itself. Few farmers are in a position to pay cash for machinery; quite rightly they expect to finance a good part of their investment in these capital goods from the income which they produce. Moreover, farmers prefer to buy machinery only in season and to postpone purchases, where possible, until reasonably certain that they are warranted by crop prospects. As a result, the industry has an enormous inventory problem, part of which it attempts to solve by placing goods in the hands of dealers considerably ahead of the selling season. These goods too must be financed.

Thus credit has become an integral part of the market structure, without which the widespread adoption of efficient machinery would have been seriously retarded. Irregular selling seasons and payments geared to farm income, however, add to the complexity of farm machinery credit. The using seasons for machines are highly variable. Harvesting machinery may be used only once or twice a year, plows usually twice, planting machinery only once, and so on; farmers' income from the use of such machines is likewise variable.

It is obvious therefore that the financing of farm machinery sales is a special breed of credit operation, calling not only for financial strength but also for a considerable knowledge of the nature of farm operations

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and of the machinery being financed. This is the leading factor explaining why the bulk of the financing has always been done by the producers of farm machinery themselves. Commercial banking principles and practice have never been adapted to such credit, and the unique instability of farm income over the years has by no means enhanced its attractiveness in the eyes of the banks.

In the years prior to World War II, there was little system to the industry's credit extension, practices being geared to on-the-spot expediency rather than to over-all policy. In many cases, companies accepted farmers' paper only with recourse to dealers, a definitely destabilizing element in the market structure. Enlarged bad debt losses in the 1930's, reflecting a somewhat reckless approach to credit in the buoyant late 1920's, took a heavy toll from both dealers and companies. Clearly a new approach was called for; this emerged during the postwar years.

Such were the major characteristics of the market for farm machinery at the outbreak of World War II. Since the war, although the structure of the market has not undergone any substantial or rapid change, a number of modifications have taken place, or appear to be in process. The remainder of this paper examines some of these modifications.

## Physical and Technological Factors

The outstanding physical changes in the market have resulted largely from the technological development of machinery itself. Specifically, I refer to the impact of power farming, or the tractor revolution. Centralization of farm tractor production in the implement industry, and the wide adoption of the power-take-off were complete by the middle '20s. Their full impact on agriculture, however, was delayed by the depression and the war. Since the war the economies of scale obtainable through the use of the larger and more expensive power equipment have had the effect of increasing the most economical size of the farm unit, of contributing to a reduction in the number of farms, and of literally forcing a drastic increase in the degree of farm mechanization. Between 1941 and 1956, in Canada, for example, total farm acreage remained almost constant at 173 million acres; yet about one out of seven farms went out of existence as separate entities, and average acres per farm increased from 237 to 302. In the same years, the ownership of machinery and equipment on farms increased some three and one-half times. Figures for the United States show that the trends there have been in the same direction and even more pronounced.

Parallel changes have taken place in the distributive structure for farm machinery. Substantial reductions have occurred in the number of dealers, some as a result of mergers between manufacturing firms, but most as

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a result of the decreasing number of farms and the impracticality of marketing expensive machinery such as tractors and combines through weak or unreliable dealers. Between 1940 and 1958, dealerships in the United States decreased from 27,500 to 18,000. A similar reduction in dealerships took place in Canada, from about 13,000 to 9,000.

The reduction in the number of dealers has been accompanied by a general raising of their calibre and financial status. Dealers today must know the features of the complex machinery they sell. They must be capable of assisting farmers in making economic decisions regarding purchase. They must maintain service facilities and stocks of repair parts. In the future, greater demands will be placed on dealer financial strength and ingenuity in order to cope with the increasing flow of trade-in machinery, and of used machinery coming onto the market from marginal farms which are being abandoned. Moreover, dealers are being encouraged by the companies to fortify themselves by handling supplemental lines more or less allied to farm machinery, such as small crawler tractors for construction work, and so on.

Thus we find that already the average net worth of dealers in the United States has increased from about \$25,000 in 1940 to \$96,000 in 1958. It seems certain that this trend will continue, making entry into the field more difficult, and ultimately eliminating the still considerable number of "curbstone" dealers whose ambition, ability or financial strength have not kept pace with the requirements of the market.

In this connection, the effects of the possible spread of integration in farm operations merit speculation. The future of integration is not at issue here, and its ramifications are obviously too great to treat in detail. Nevertheless, if integration were to spread widely throughout agriculture, it would at the very least have the effect of hastening the disappearance of marginal farmers, and probably of quickening the interest of farmers and processors in the use of new, more efficient methods and machinery. In both cases, the effect would be in favor of the larger dealer, because of the added pressure created on the used machinery market and of the increased awareness required of dealers of the problems of farmers and the machines best suited to meet them.

All of these changes suggest that the excess distributive capacity is being wrung out of the market structure in some measure; and that the future will bring a greater measure of stability to the dealer structure than has been heretofore known. This belief is supported by the unlikelihood of a recurrence in the future of the pressures which have kept the dealer organization in a state of instability over long periods in the past.

There was, for example, the wave of mergers in the industry between 1890 and 1915, and its destabilizing effect on dealers. Although mergers

are still a definite possibility in the case of some of the smaller full-line firms, they will never resume their earlier importance. There was an intense and prolonged period of spatial competition and market uncertainty during which the market was expanding geographically, lasting in Canada as late as 1930. This is now complete. And finally, the tractor revolution brought about, as has been seen, new demands on dealers and the elimination of thousands of dealerships. Technological improvements will continue to be made in farm machinery, but there are no advances imminent whose effects will be comparable to those of the combine when it succeeded the binder, or of the tractor when it became the power source for all machinery.

#### Financial Factors

Before dealing with the financial factors, we might note some of the main features of the company-dealer relationship. Throughout most of the farm equipment industry, the company-dealer relationship is based on purchase contracts, under which dealers agree to purchase from the companies at prices somewhat below (usually by about 20 per cent) the manufacturer's list price, the machines which they have ordered. Thereupon the machine becomes the property and responsibility of the dealer. In some cases such as where farm income falls below expectations, or where competition forces an adjustment, companies may make interim concessions in list prices. Companies do not generally announce such price cuts, but rather offer to dealers a bonus on sales of the affected machines, leaving them free either to offer a higher trade-in allowance or to keep the bonus if they sell at full price. Under purchase contracts, dealers generally agree to maintain facilities for servicing machinery. During warranty periods, companies pay the labor cost of service covered by the warranty, the usual practice being to pay the dealer 50 per cent of his regular service charge. Since the dealer's regular service charge is normally double his labor rate, 50 per cent is assumed to cover the labor cost.

Purchase contracts have been the prevailing practice in the United States since the early part of this century. Consignment contracts, under which the dealer acts in the capacity of a commission agent for the company, were widely used in Canada prior to 1945. In that year, sellers in Canada shifted over to purchase arrangements, which since then have been almost universal throughout Canada and the United States.

From the point of view of company accounts and that of dealer responsibility for the machines, there are some real differences between consignment and purchase arrangements with farm machinery dealers. From the point of view of financing the machinery, however, not much

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real difference exists. The fact is that in both instances the company stands ready to do the bulk of the financing, i.e. to carry the machine both while it is in the hands of the dealer and after it has been sold to the farmer. The resulting credit load assumed by the implement industry probably exceeds that of any comparable heavy manufacturing enterprise.

Let us take a typical example from the credit practice of one of the leading full-line firms. The company provides not only inventory financing for new complete machines and repair parts purchased by the dealer, but also inventory financing on used machines taken in trade, and financing service for retail installment paper advanced by buyers. Inventory financing is done without any interest charge or additional cost, and without requiring a down payment. Terms of payment are related to the normal selling seasons for the machine rather than a stated length of time after purchase by the dealer or user.

To illustrate, if the company shipped six combines to a dealer on or after November 1, 1957, no payment would be required, except if a machine had been sold, prior to November 1, 1958. On that date payment for three of the machines (50 per cent of the original delivery) would be due, the other three being carried over until August 1, 1959, 21 months after delivery. Settlement is, of course, due immediately if a machine is sold.

When sale is made to a farmer, the dealer usually takes a used machine in trade, and the company will finance this machine without interest or down payment for four months, after which it may be extended at 6 per cent interest. Should the dealer sell this machine, taking a second used machine in trade, the company will again finance him in a similar manner in the second trade-in. Meanwhile the company stands ready to finance, without recourse to the dealer, acceptable farmers' notes taken in payment for both the new and the used machines. The company withholds 3 per cent of the face value of such notes in a reserve against which losses may be charged, and any excess in this reserve above 5 per cent is returned to the dealer. This method helps to protect the company against loss and spurs the dealers to avoid risky trades. On retail sales, the company requires that the dealer take at least a 30 per cent down payment, permitting the balance to be spread over as many as 40 months on expensive machines. In other words, it is entirely possible that as much as five years could elapse between the time of original shipment by the company and the receipt of final payment for the machine.

This is large-scale finance for a manufacturing company. The company referred to above is currently financing inventory purchased by its dealers in the United States to an average of about \$40,000 per dealer and has total receivables from dealers of about \$150 million. This increasing

burden of credit has forced a complete reassessment of credit policy throughout the industry since World War II, as a result of which the major companies, including International Harvester, John Deere, Massey-Ferguson, J. I. Case and others, have now set up separate financial subsidiaries to handle all matters pertaining to the financing of sales. Under this new approach, almost the last vestiges of responsibility for credit have been lifted from the shoulders of the dealer, a development which gives added reason to expect greater stability at the retail level in the future.

In Canada, a further stabilizing element in the credit picture has been the Farm Improvement Loans act of 1944. The Canadian government had long recognized as undesirable the farmers' necessary dependence on manufacturers and merchants for credit in purchasing capital requirements. As far back as 1937 the special committee on farm implement prices had reported:

"The companies point out that they extend credit to the farmers when  $_{10}$  other credit agencies will extend such credit to them. Having in mind the terms on which this credit is extended, the committee regrets that some agency such as our banks or other loaning institutions has not evolved a method whereby credit for this purpose could be extended to the Canadian farmer on a more satisfactory basis."

In answer to pleas of this sort, the Farm Improvement Loans act was designed to encourage Canadian banks to provide intermediate and short term credit to farmers, through a guarantee against losses up to 10 per cent of a bank's aggregate loans under the act. Such loans may be made up to \$5,000 for any individual farmer for specified purposes and at a maximum of 5 per cent interest. From its inception to the end of 1957, \$638 million had been loaned under this act for the purchase of farm implements and machinery.

Although the Farm Improvement Loans act had operated fairly successfully, there is still reason to believe that many local banks have not participated to the degree warranted by the government's guarantee. This seems to have resulted not only from a lingering reluctance on the part of many bankers to become involved in agricultural credit but, in the case of farm machinery, from the difficulty of arranging convenient and adequate security for the loan. The government still requires that banks repossess and sell a machine before a claim made by the bank can be paid. Some change in this latter stipulation will doubtless have to be made in the future. Banks have no organization for dealing in used implements, and under the present conditions, the repossession and resale are frequently handled in a perfunctory manner by the bank's solicitor. The result of this has been losses on new claims much heavier than they should have been, considerable adverse criticism of the banks' methods of

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Whatever the difficulties experienced under the Farm Improvement Loans act, the principles on which it is based seem to hold the only lasting solution to the credit problem. The specialized credit corporations which the implement companies have set up in the postwar years are performing a necessary function in the absence of anyone else able and willing to take it on. There seems little doubt, however, that the implement companies would willingly move out of the credit field if some other institution could, and would, move in. To quote William A. Hewitt, president of John Deere and Company, in January, 1958:

"We provide (credit) because we must. In so doing, it is neither our wish nor purpose to compete with banks. Our evidence for this is the fact that much of the farmer paper we accept from dealers generally carries higher rates than banks charge for such paper, and our rates are as low as any in the industry. . . Surely the limited availability of credit from other lower-cost sources must be a factor in this situation. . . . I say that any bank that will extend credit of this sort to farmers without recourse to our dealers is most welcome to all the business it can get"—(Address to the 10th National Credit Conference, The American Bankers' Association)

The basic fact of implement credit is that no one can select ahead of time any farmer who will keep up payments of principal and interest on time if a succession of years of drought and low prices follow the purchase. In such an event, which in the light of current official crop reports does not seem at all unlikely for the near future in some areas of Saskatchewan, the heavy depreciation on modern machinery will intensify farmers' losses, and will impose a very severe strain on the credit facilities of implement companies.

It has yet to be demonstrated, and it seems unlikely, that any credit facility, dealing only in farm equipment loans and holding only farm equipment as security, could survive the strain of a prolonged agricultural depression. Such a condition has not prevailed since World War II. Nevertheless, its likelihood for the future, at least in some major segments of the market, is sufficient to warrant action from official sources and from the industry itself. Again, therefore, it is suggested that the only lasting solution lies in the greater flexibility available through bank credit backed, if necessary, by a government guarantee against loss. Even here, however, the Canadian experience has made clear that, before this principle can operate with full success, the banks and the farm machinery companies must develop a much closer working relationship than has existed in the past. Only in this way would banks be enabled to acquaint themselves more closely than they have done hitherto with the peculiarities of farm machinery credit, and to appreciate the extent

to which such credit, judiciously extended, offers profitable opportunities for lending. As for the matter of security, dealers and banks might well get together to look into the possibilities of dealers' storing, reconditioning and selling machines which the banks have been forced to repossess.

## Other Developments: Machinery Rentals

The trend toward expensive machinery and the general lack of buoyancy in the implement market in recent years has led to much discussion of the feasibility of machinery rentals. Within the past month I visited and interviewed officials of the National Retail Farm Equipment association, St. Louis, and of the leading farm machinery companies in Moline, Chicago, Racine, Toronto and Brantford, with a view toward learning their problems and ideas on implement marketing, and especially their views on the future of rentals. The latter may be summed up as follows:

The attitude toward renting is generally one of caution, but it is felt throughout the industry that, at present, renting of farm equipment is not as widespread as is commonly supposed. The renting that is being done is not on any systematized basis and the initiative is coming entirely from dealers who are renting machines to which they have clear title.

The national dealers' association in the United States appears to have modified its views considerably since last November when it expressed enthusiasm over the idea of renting both new and used machinery. At that time the dealers' association issued a release to dealers pointing out that:

"From the standpoint of the farmer or contractor, there are definite advantages to renting equipment. One is tax savings. Second, renting conserves working capital. These factors provide a real incentive to lease equipment for the short periods of time extra equipment is needed during the year. From your standpoint, this trend offers an opportunity to 'cash in' on a market that has so far been untapped. It gives you an opportunity to put idle 'trade-ins' to work—at a profit. Or, you can lease new machines at the same rate and recover cost with eighty days' rentals."

While the association still supports the principle of renting its view now is that it should be limited to used and reconditioned, rather than new, equipment.

The leading manufacturers are generally opposed to the rental idea, although they readily admit that if a dealer has made full settlement for a machine he is quite entitled to rent it, whatever the company may think. Some companies oppose even this type of renting on ideological grounds. Opposition is universal to the idea of a dealer renting out a machine for which he has not made final settlement with the company. Nevertheless, the leading companies in the industry produce industrial machinery as

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well as farm equipment and so are familiar with the idea and practice of leasing machinery. All have made provision for adapting their agreements currently used in renting industrial machinery to farm equipment, and stand ready to do so if competitive conditions make it necessary. Were this to come to pass, the plans would probably call for accepting the lease itself as collateral for the machine. But each of the leading companies claims that it will not be the first one to make such a move.

It appears, therefore, that while company-supported renting by dealers is by no means imminent, there is a strong possibility that it could develop should any company seek to take advantage of the economic appeal which the idea carries for farmers, particularly those temporarily in need of extra machinery. In any tight market situation in the future a strong temptation will be present for companies to move extra machines into the hands of dealers for rental purposes under some form of accelerated payment plan. At current rental rates, a very attractive proposition could be worked out where a dealer might acquire full ownership through rental payments in a relatively short time. The competitive aspects of such a possibility are interesting, since this is a situation where the gains, though probably short-lived, would accrue to the company which made the move first. Should the practice ever become common throughout the industry, any extraordinary gains would be cancelled out.

## Cooperative Selling of Farm Machinery

Another development of comparatively recent origin has been the selling of farm machinery through cooperative organizations. I have dealt with this subject elsewhere (Farm Implement Industry in Canada, University of Toronto Press, 1956) and, because of space limitations, shall not attempt to present more than a few random observations here. Briefly, it may be said that cooperative activity in farm machinery has developed along three lines. One of the Canadian full-line firms has, since 1945, turned out a portion of its output bearing a distinctive color and the "Co-op" name. This has been sold directly to regional cooperatives in the United States, and to Canadian Cooperative Implements Limited in Canada, which in turn have sold it to farmers through their own outlets, ostensibly as cooperative machinery. Secondly, some, though not all, of the other full-line firms, as well as a number of the short-line specialty firms, sell their machinery to local cooperatives in certain areas. This machinery is generally not distinguishable from that sold through the companies' own dealers. Finally, cooperatives themselves have, to a limited extent, gone into implement production.

Despite the importance of cooperative selling in some areas, it appears still to be insignificantly small in the total market. There is no doubt that cooperative selling of farm machinery can mean real economies.

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Just as real, however, are the difficulties which have restricted its volume in the past and may continue to do so in the future. These difficulties reflect the peculiarities of the market itself. There are, for example, the problems of credit, servicing and trade-ins. It may or may not be true, as many in the implement industry ruefully suggest, that that industry has for so long "babied" the farmer in these respects that he now expects greater patronization from implement sellers than from any others. It does seem true that farmers do not buy machinery as they buy other commodities. They have become accustomed to having their machinery sold to them. Thus many sales methods and practices which are clearly dispensable in the selling of most goods have come to be considered "essentials" in the sale of farm machinery until the usual economies of cooperative sale are extremely difficult to attain. It would seem, therefore, that a long-standing mode of thought among farmers must be changed before large-scale success can come within reach of the implement-selling cooperatives.

#### DISCUSSION: THE CHANGING STRUCTURE OF MARKETS FOR FARM MACHINERY

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I think we are fortunate that a man with Phillips' background and experience was chosen to give the opening paper at this session. To me this is a historic occasion, for this session recognizes what has existed for a long time: namely, that in agriculture there are production supply markets as well as commodity markets. The importance of this generally neglected area in the thinking of agricultural economists is indicated by the fact that farmers now spend nearly 50 per cent of their cash income on production supplies and related services.

After briefly reviewing the structure of the market for farm machinery prior to World War II, Phillips concerns himself with "... changes which have been, or are, taking place since then." He discussed certain physical and technological factors, emphasized financial arrangements, and closed with an exploration of machinery rental and cooperative selling. Except for such observations as I will develop on certain points of Phillips' paper, I find myself in substantial agreement with many of the ideas that he presented.

In his discussion of physical and technical developments, Phillips attributed reduction in the number of machinery dealers primarily to the decline in the number of farms during the past few decades. This interpretation may be subject to some question. It generally is agreed that the

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extensive use of machinery has resulted in larger farms and, perhaps even more important, in larger fields on these farms. As farms increase in size, more, rather than less, machinery is required. It is somewhat difficult to see how this would lead to fewer dealers.

Furthermore, we need to consider the actual decline in the number of dealers. Phillips may have used census figures in arriving at this number. However, the major machinery manufacturing companies in the United States now report about 23,000 authorized dealers. I am inclined to believe that such factors as greater diversification in dealer operations, increased financial requirements, and ability to adjust to the growing complexities of the present day farm machinery business have been more important than a reduction in number of farms in explaining trends in dealer numbers.

Even on these points, however, we need to exercise care in any appraisal. The present number of dealers may quite likely reflect the general level of economic activity in the industry and the inclination of manufacturers to "hang on" to dealers in the hope that future volume will justify their continued existence. A few years of economic adversity could seriously reduce dealer assets and undermine what Phillips chooses to suggest is a status approaching "stability" in the industry—a status which is more fictitious than real, as I shall later emphasize.

Phillips also speculates on the possible impact of integration on farm machinery markets. Looking at the impact on farm operations, he says that if integration spreads widely through agriculture ". . . it would at the very least have the effect of hastening the disappearance of marginal farmers. . . ." Certainly I agree that further integration would tend to eliminate existing marginal farmers. But does Phillips believe that this might stabilize the marginal farmer situation? I see a new set of marginal farmers appearing as soon as the present ones disappear.

A more fruitful aspect of integration might well have been to explore its ramifications in the market structure. For instance, it is generally recognized that the strong credit ties between manufacturer and dealer places the latter in what some people describe as a "captive" position. The manufacturer makes the basic decisions, establishes the terms, and maintains sufficient control over dealer operations. Thus, in effect, the dealers are vehicles for effectively integrating manufacturers' activities.

Phillips' observations on wringing out excess distributive capacity opens up an area of integration that is of special concern to farmers. I find it difficult to share his optimism as to the likelihood that such wringing out will be accomplished and a greater degree of stability attained. A number of factors suggest that for practical purposes the field may be more overpopulated now than at any time in the past few

decades, notwithstanding some declines in absolute numbers. Some of these are: improved roads, better communications, and changing financial requirements with resulting excessive duplication and competition.

All this adds up to a market structure for farm machinery that emphasizes many of the weaknesses that often characterize production supply markets. The experience of farmer cooperatives in the manufacture of farm machinery in the United States and Canada generally has been limited, as Phillips suggests. The growing importance of machinery as an item of production costs, however, may well mean that farmers will be inclined to take a second look at integrating as it relates to this industry. This is in line with the need for a change in the mode of thought that Phillips stated is needed if further distribution through cooperatives is to be achieved.

The joint ownership of farm machinery is a practice that might be explored further. The possibility of bypassing costly and duplicating distribution services, the opportunity of providing their own financial arrangements, and the need for obtaining related services geared to changing farm needs, all are considerations that bear on the farmers' interest in integrating their operations with the farm machinery industry so as to achieve some measure of market control.

Phillips closes his discussion on physical and technical factors by looking into a crystal ball and saying, "... there are no advances imminent whose effects will be comparable to those of the combine when it succeded the binder, or of the tractor when it become the power source of all machinery." As I look in my crystal ball, I see developments in the next 40 years that in all likelihood will dwarf those that have occurred

in the past 40 years—important as they have been.

In his observations on financial factors, Phillips devotes considerable attention to manufacturer-dealer relations. While present purchase and sales arrangements may be considered the accepted practice, I believe that a careful look at this practice would indicate little real change from the consignment arrangements that formerly prevailed. For instance, dealers do not pay for machines that don't sell. Manufacturers move them on to dealers in other areas. Commenting on credit, Phillips recognizes that no real difference exists in this practice regardless of whether contract and sales or consignment methods of operation are used.

On another aspect of credit, namely, that manufacturers gladly would relinquish the credit arrangements they have developed, there are many who would disagree. This is because the granting of credit has become

a profitable activity for those manufacturers who provide it.

An evaluation of machinery rental perhaps should include custom hire —a practice that has become especially important in the baling of hay

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and combining of grain. Indications are that interest in rentals will rather closely reflect the extent of machinery sales and economic conditions in the industry. Because of the idealogical opposition voiced by some manufacturers, it seems that further development of this practice likely will have to come from aggressive dealers. They are apt to be in areas that cannot support sales of individual machines to farmers or where farmers need supplementary machinery in addition to that already owned.

The wide range of problems that have been pinpointed by Phillips offers a challenging field for students in agricultural economics. He has made an important contribution in bringing them to our attention.

# THE CHANGING STRUCTURE OF THE FERTILIZER INDUSTRY IN THE UNITED STATES

E. L. BAUM AND S. L. CLEMENT<sup>®</sup>

Tennessee Valley Authority

ONSUMPTION of fertilizer nutrients in the United States since World War II has doubled from 3 million to 6 million tons of plant nutrients. This represents a spectacular growth by an industry. In the West North Central states, plant nutrient consumption during this decade has increased four times; in the East North Central states, it increased one and one-half times; and even in the South Atlantic states where commercial fertilizer has been used for over a century, plant nutrient use increased about 35 per cent (see Table 1). This sudden expansion of the industry has been accomplished by marked changes in the marketing structure, not only as to form, participants, practices, and goods handled, but also as to the market and plant location, fertilizers demanded, and fertilizer uses.

Of interest to us, and of importance to the topic under discussion, are the reasons for this phenomenal expansion and growth in the fertilizer

industry.

The embryonic stages of development in the commercial fertilizer industry of the United States started about a century ago. Justus von Liebig's research work in plant-soil relationships in Germany had shown that nitrogen, phosphorus, and potassium were essential plant nutrients, and that often they were in too limited quantities in the soil. Other pioneers like Lawes and Gilbert in England, through their early production and experimentation with fertilizers of organic and/or by-product origin, did much to advance fertilizer technology.2 Initially, imports of guano were used to supply industry's needs to fulfill farmers' demands for fertilizer. Sodium nitrate from Chile was also imported at an early date. By-products from slaughtering plants, coke-oven operations, and other industries plus imports provided the principal sources of fertilizer in the United States for many years. Fundamental to the organization of any industry are those agencies which actually handle the physical goods which are the products of the industry. In the fertilizer industry, these agencies are (1) importers and exporters, (2) primary producers, (3)

<sup>1</sup> A. L. Mehring, et al., Statistics on Fertilizer and Liming Materials in the United States, Statistical Bulletin No. 191, USDA, April 1957, Table 105, p. 106.

<sup>2</sup> Mirko Lamer, The World Fertilizer Economy, Stanford: Stanford University

Press, 1957, chap. 3, pp. 31-58.

<sup>\*</sup> Appreciation is extended to John R. Douglas, Jr., and Harold G. Walkup for their valuable assistance in developing the basic data necessary for the preparation of this paper.

Table 1. Percentage Change in Fertilizer Consumption, by Regions, 1946<sup>a</sup> to 1957<sup>b</sup>

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+ 1	5.8 +142.1	+ 263.9	+ 16.8	+ 83.3	+115.0	+ 44.7	+ 59.5
		+ 466.6	+168.3	+165.9	+159.2	+ 49.0	+130.0
Il fer- +14.5	5.2 + 55.9	+ 63.9	+ 37.8	+ 37.8   + 71.6	+ 43.2	+ 68.2	+ 45.1

• A. L. Mehring, J. R. Adams, and K. D. Jacob, Statistics on Fertilizers and Liming Materials, USDA Statistical Bulletin No. 191, Agricultura Besearch Service, April 1957.

b W. Scholl, M. M. Davis, and F. B. Crammatle, Consumption of Commercial Fertilizers and Primary Plant Nutrients in the U.S., Agricultural Research Service, 41-19-1, June 1958.

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brokers and wholesaler distributors, (4) mixers, (5) retail dealers, and (6) ultimate users.

Changes in the marketing structure for fertilizer have been and are being "triggered" by technological, economic and sociological, institutional, governmental policy, and other dynamic factors. Our assignment is to present and analyze the nature of the fertilizer marketing structure as it exists today, the forces that have contributed to the present structure, and some changes that may occur in the future in the United States.

Commercial fertilizer entering the channels of commerce consists of a very large number of specific products each containing to some degree, nitrogen, phosphorus, and/or potassium.<sup>3</sup> Some of these products—particularly the straight materials—are more or less suitable for further processing into other fertilizer products, or in their present form may be used for direct application to the soil. Additional nutrients (minor elements) essential to plant growth and in short supply in some soils frequently are added to mixed fertilizers.

Fertilizers were initially distributed in solid pulverized form. At present, fertilizer materials are available as gases, liquids, and solids. The largest amount is still distributed in the solid pulverized form, although there has been a marked increase in the manufacture and use of granulated or pelletized dry form fertilizers to replace the pulverized form. Large increases are developing in the use of gaseous and liquid forms (especially nitrogen) in many of the principal agricultural areas.

#### Market Structures in General

The structure of markets with which agricultural economists usually are concerned frequently resembles the shape of an hourglass; that is, from a widely scattered production area the product, through a series of steps, is concentrated and processed, and then, through another series of stages, the product in its final or near final form is distributed to widely scattered consumption areas.

The general structures of the fertilizer industry and of the markets through which its products move represent typical nonagricultural industry configurations. This is a pyramid structure with a few producers at the top developing from concentrated sources of raw materials the primary semifinished products of the industry. A fanning-out to a larger

<sup>&</sup>lt;sup>8</sup> Fertilizers are designated by grade as to their content of nitrogen, phosphorus pentoxide (P₂O₅), and/or potassium oxide (K₃O). Thus, a 5-20-20 mixed fertilizer contains 5 per cent nitrogen, 20 per cent P₂O₅ or its equivalent in terms of phosphorus, and 20 per cent K₂O or its equivalent in terms of potassium. Carriers of single nutrients are designated as straight materials, such as 33.5-0-0 for ammonium nitrate.

<sup>&</sup>lt;sup>4</sup> Fertilizers Applied in Liquid Forms, Agricultural Research Service Special Report 22-35, USDA, November 1956.

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and larger area occurs as these primary products move through the marketing channels, and from points of further refinement or production.

## Location of Raw Materials and Capacity for Production

Each of the primary nutrients—nitrogen, phosphorus, and potassium—has its own unique dimension for extraction from nature. Fundamental to each of these processes is the utilization of highly concentrated sources of raw materials, and the existence of high value alternative commercial uses for that portion not utilized for fertilizer. The state of the arts continues to change as new techniques of production are developed. When these changes occur, significant changes in the structure of markets may reasonably be expected to follow.

## The Nitrogen Industry

The nitrogen fertilizer industry of today is composed of four principal segments in providing material for the fertilizer industry. In their relative order of importance these are: (1) synthetic, (2) coke-oven by-products, (3) imported nitrogen salts, and (4) organic by-products. At present, it is estimated that the first three sources supply about 97 per cent of all fertilizer nitrogen used, and that about 90 per cent of all fertilizer nitrogen moving through the marketing channels and being used has its source in a synthetic process.<sup>5</sup>

Some of the products which are representative of the various sources from which they come are as follows: (1) synthetics are such fertilizers as anhydrous ammonia, nitrogen solutions, aqueous ammonia, ammonium nitrate, urea, ammonium phosphates, and ammonium nitrate-lime; (2) coke-oven by-products are primarily ammonium sulfate; (3) imported nitrogen salts are primarily sodium nitrate and potassium nitrate; and (4) organic by-products are such materials as dried blood, fish scrap, and tankage.

Prior to World War II, domestic production and imported materials each furnished about 50 per cent of the nitrogen used in commercial fertilizer. The principal domestic production was in the form of ammonium sulfate, a by-product of coke-oven operations. The imported material was principally sodium nitrate from Chile. Coke-oven by-products production of ammonium sulfate was manufactured in about 80 plants having a rated capacity of 200,000 tons of nitrogen. However, these were used at only about 50 per cent of capacity. These by-product operations have not changed materially as to number of plants, capacity, or actual production since the mid-twenties.

<sup>&</sup>lt;sup>5</sup> A. L. Mehring, et al., Statistics on Fertilizer and Liming Materials in the U.S., Statistical Bulletin No. 191, USDA, April 1957, Tables 1, 4 and 5.

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In the immediate pre-World War II era, total imports of nitrogen to the U.S. reached approximately 220,000 tons, of which all except perhaps 5-7,000 tons were used annually for fertilizer. The production of synthetic nitrogen which was to develop into the major source for fertilizer nitrogen was concentrated in the hands of three major producers prior to World War II. The principal initial stimulus to the present day nitrogen industry was provided early during the World War II period. This was accomplished by the government building 10 large synthetic ammonia plants with a total capacity of about 800,000 tons of nitrogen. By late 1942, it was evident that not all of the nitrogen that could be produced by the industry and government plants (including the TVA plant), would be needed for explosives or other military uses. At the same time, the need for fertilizer nitrogen to increase food production became increasingly acute. Hence, the TVA plant was released for the production of fertilizer grade ammonium nitrate in 1943 to aid in emergency food production, Private companies also decided to initiate the production of fertilizer grade ammonium nitrate, and the new nitrogen industry of today was launched in the United States.

In fiscal year 1943 there were two producers of solid fertilizer grade ammonium nitrate in the United States—the TVA plant at Muscle Shoals, Alabama, and Hercules Powder company at Pinole, California. During this year, about 18,000 tons of ammonium nitrate fertilizer were used, of which TVA produced 75 per cent. By 1957, American farmers were using over 1,000,000 tons of ammonium nitrate as a straight material for direct application on crops. Approximately 20 plants with a capacity estimated to be well over 1,500,000 tons of solid fertilizer grade ammonium nitrate are currently in operation.

Another important product, and one which has had a powerful influence on market structure in the fertilizer industry of today, is anhydrous ammonia, the initial and most concentrated nitrogen product from the synthetic process.<sup>6</sup> In 1943 there were 17 anhydrous ammonia plants in the United States, including eight government plants which had been constructed at that time. The total number has now been increased to over 60, with large expansions in capacity, installed at most of the original locations. Capacity for production at these plants is not known precisely, but it is estimated to be over 4,000,000 tons of nitrogen annually, which includes that available for industrial use. This represents a 10-fold increase in productive capacity since 1940 and a five-fold increase since 1943.

Anhydrous ammonia is a gas at ordinary pressures and is the only gaseous fertilizer used as such in mixed fertilizer operations and for direct application to the soil. It is stored and transported under pressures sufficient to condense it to a liquid state. It contains 82 per cent nitrogen.

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It is te. It There have been and continue to be marked changes in the forms of nitrogen fertilizer available for use on farms. The use of solid ammonium nitrate as a straight fertilizer material has increased to over 1,000,000 tons annually. Anhydrous ammonia, liquid ammonium nitrate solutions, and various other liquid nitrogen solutions are receiving increased attention and use. Very high analysis materials, such as diammonium phosphate containing 21 units of nitrogen and 53 units of available phosphorus pentoxide, are becoming increasingly available. And on the horizon is a whole series of mixtures of nitrogen and phosphoric acid, both solids and liquids, which may soon flow through the marketing channels and be used in complete mixtures and also directly on American farms.

The nitrogen industry since World War II has noticeably expanded, not only as to capacity and production, but also as to diversity of products and as to larger numbers of companies in the business. This has resulted in increased competition in the nitrogen segment of the fertilizer industry. Instead of having a "Big Four" there are now at least 17 major producers of synthetic nitrogen products and these are widely distributed throughout the United States. Most of these companies are primarily chemical or petro-chemical companies. Technical advances, low cost government surplus plants, rapid depletion allowances, opportunities for diversification, and the development of an expanding fertilizer market all have played their part in bringing many of these newcomers to the industry.

## The Phosphate Industry

In contrast to the synthetic nitrogen industry, the phosphate industry of the United States is much older. Due largely to limited areas of suitable phosphate minerals which are owned or controlled by a limited number of firms, the competitive aspects of the industry are quite stable. Recent estimates indicate that of the total United States' phosphate reserves in the three areas in which economical production can be achieved, 38 per cent is located in Florida, 61 per cent in the western fields of Utah and Idaho, and 1 per cent is located in Tennessee. At present, three-fourths of the phosphate rock mined in this country comes from the Florida fields, and about equal amounts of the remaining 25 per cent from the western and Tennessee fields.

The western fields were not tapped extensively until the late 1940's, although the presence of these reserves had been recognized for a long time. In 1934 only 1 per cent of the rock mined came from the western fields and in 1946 only 7 per cent came from there; yet by 1957, 13 per cent of all rock mined came from the western fields.

There are some indications that two TVA developments in the field of phosphorus will accelerate the production of phosphatic fertilizers from western deposits. These are (1) the development and wide-scale intro-

duction of calcium metaphosphate containing 62 to 64 per cent phosphorus pentoxide, and (2) the more recent development of superphosphoric acid, containing approximately 50 per cent more phosphorus pentoxide than the normal commercial product. At least one new plant is under construction in the western area to utilize these developments. The high concentration of plant nutrients in these products makes it economically feasible to ship them over a wide area from the point of production.

During the 70 years prior to 1930, some 200 phosphate fertilizer plants had been built with an annual capacity of about 1,600,000 tons of available phosphorus pentoxide equivalent. These facilities were used at less than one-half capacity. The principal product developed for fertilizer was ordinary superphosphate containing up to 20 per cent of available phosphorus pentoxide. By the late 1920's, five concentrated superphosphate plants were constructed by private industry which permitted the production of a 45 per cent available phosphorus pentoxide product. However, very little of this product was sold to farmers either as a straight fertilizer material or in mixtures.

Concurrently with TVA's production of concentrated superphosphate and the encouragement of its use by farmers and mixers through its fertilizer education program and other public programs, the industry has been encouraged to increase the production of this more concentrated material. Ordinary superphosphate still occupies an important place among phosphate materials, having doubled production to over 1,500,000 tons of available phosphorus pentoxide since 1930. During the same period, its production capacity has also approximately doubled. The primary phosphate material showing the most marked increase in production is concentrated superphosphate. From an annual production and use of approximately 30,000 tons in 1934 its use has increased to over 750,000 tons of available phosphorus pentoxide in 1957. A large potential increase in the production of this material exists in the western fields, where several companies are in the process of increasing their capacity for production.

Another technological change which has developed in the phosphate industry perhaps as a direct result of changes in the nitrogen industry is the production of ammonium phosphates. Production of these materials (primarily 16-20-0, 11-48-0, and 13-39-0), and later diammonium phosphate (21-53-0) actually began on a commercial scale in the late 1940's. As late as 1946, only about 50,000 tons of these materials were being used as straight materials in American agriculture, and these almost entirely on the West Coast. By 1957 almost 400,000 tons of these materials were used as straight materials for direct application, and farmers in most areas

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of the country were becoming familiar with them. The advantages which these materials offer-high analysis, high water solubility, and chemical combinations of nutrients-promise a larger trend to their use. Another change which apparently is coming about is the trend toward the use of liquid phosphoric acid as a straight fertilizer material (on the West Coast primarily), or in the form of liquid mixed fertilizer. Prior to recent technological advances in the manufacturing process, both by the wet process and in the electric furnace method, the cost of this liquid phosphoric acid was prohibitive for use as a fertilizer agent. Yet with the recent advances and in particular as a result of the increased supply of the material it offers great promise to supplement the very low cost nitrogen solutions. Until 1949 it had been used as a straight fertilizer material only in Arizona and California, and less than 6,000 tons had been used in only one year. By 1957 its use had tripled to over 18,000 tons and, with increased supplies rapidly becoming available at reduced prices, it may continue to have a rapid increase in the future.

Another factor which promises to result in a greater use of liquid phosphoric acid is the development by TVA of the superphosphoric acid, equivalent to 105 per cent phosphoric acid in terms of P<sub>2</sub>O<sub>5</sub>. If favorable freight rates are established on this type of material, another step forward will have been taken in aiding farmers to obtain better fertilizers more economically. This material, in addition to being highly concentrated, offers some promise of helping the liquid mixers in their technical problems of mixing liquids which do not "salt out," "gel," or form precipitates which clog spreading equipment.

# The Potash Industry

The potash industry as it exists today, has existed only since the beginning of World War II. Progress, however, has been quite different as compared to the other two primary components of the fertilizer industry with respect to the entrance of new firms and technological improvements in the development of new products. There has been much progress, however, in mining efficiencies and refining methods.

The increase in size of the industry has been primarily in size and scope of the operations of various companies in the industry. Few new companies have entered the field. There were seven producing plants in 1939, four of these being major plants. By 1953 there were 10 plants producing almost two million tons of  $K_2O$  compared with slightly over 300,000 tons in 1939. Prior to 1939, practically all potash used in America was either imported or by-product material. In World War I and immediately thereafter an abortive effort had been made to begin the American potash industry; but, during the early 1920's active efforts to start the industry

were discontinued. However, research continued and exploration for deposits which could be economically mined was expanded. Deposits were located in California, New Mexico, Utah, and Saskatoon, Canada. New mining and refining methods now make it profitable to mine the potash rather than import. It is now evident that with the known deposits, the United States will not again soon be dependent upon imports.

The known annual capacity of these mines is now well over 2,000,000 tons and can rapidly be expanded if the need arises. At the same time that capacity has been rapidly expanded, the price of the material has held relatively constantly until recently. During the past year wholesale prices of muriate of potash have declined to a point where the cost of potash per unit of plant nutrient is at one of the lowest levels of all times and is much lower than nitrogen or phosphate.

The potash industry has also grown rapidly—perhaps more rapidly than either the nitrogen or phosphate industries; but the nature of the growth has been quite different. It was a growth based on the leasing of government lands by a few large companies having the capital necessary to

invest in such large mining enterprises.

#### The Fertilizer Mixing Industry

To a large extent, fertilizer products used by farmers have been mixtures of nitrogen, phosphorus, and potassium in various ratios. In some cases only two of the so-called primary nutrients constitute a mixture. The content of nutrients including chemically combined carriers plus fillers and conditioners to bring the materials "up to weight" constitute mixed fertilizers. These mixtures are usually prepared from so-called primary products of the industry—usually carriers of only one of the primary nutrients. In the past, and to a considerable degree today, primary producers of the phosphatic fertilizer materials have widely located mixing plant operations. This type of vertical integration has placed these mixers in a powerful competitive position relative to independent mixers to whom they sell primary materials.

A technological innovation of the early 1950's by TVA has improved the relative competitive position of independent mixers. This was the development of the TVA continuous ammoniator. Its use allows the mixer to produce mixed fertilizers with a higher proportion of low cost liquid nitrogen than formerly, thus effectively lowering the cost of mixed fer-

tilizers.

The TVA ammoniator has contributed further to the mixing industry and to the economy of producing mixed fertilizer, in that it permits continuous rather than batch production. It also provides the means for widespread development of improved granulation of materials and mixtures w Prim gration phosph betwee indicat ent pla the pri Fert Mixing cost in in the their I the in produ of dist ing eq

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tures which has proven advantageous for the drillability of fertilizer.

Primary producers of potash and synthetic nitrogen have effected integration into the mixing industry to a much smaller degree than have the phosphate producers. However, there is a recent trend toward integration between nitrogen producers and fertilizer mixers. There are also some indications of barter arrangements between primary producers of different plant nutrients so that a primary producer can obtain a supply of the primary plant nutrient he does not produce.

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Fertilizer mixing plants tend to be located near the markets they serve. Mixing usually involves a weight gaining process employing some low cost ingredient often available locally. Mixing plants producing dry mixes in the period prior to World War II usually marketed 70 per cent of their products within a radius of 50 miles of the plant.7 It appears that the increased efficiency resulting from large scale operation and the production of higher analysis mixes now permit a somewhat larger area of distribution. Recent innovations in the use of multiple hopper spreading equipment and bulk-blending techniques which eliminate the necessity of the added weight of fillers and problems inherent in mixing may, however, reduce the trend to larger mixing plants by the mixing industry.

#### Changes in Use of Fertilizer on Farms

Many of the agricultural areas of the United States have only recently been awakened to opportunities which are available to farmers to increase income through the use of fertilizer. This increase in the demand for fertilizer has resulted from a large number of conditions and improvements in other factors of production as well as fertilizer. By considering the factors governing demand separately we can see how each has con-

tributed to the continuing expansion of fertilizer use.

During World War II farmers produced unprecedented amounts of food and fiber to support the war effort. As a result, there was a large draw-down in the fertility reservoir on the farms of the nation, Improved plant varieties, herbicides, and pesticides were developed after the war. These conditions set the stage for a very large increase in demand for fertilizer. The government's acreage control program without restrictive use of other factors of production also contributes to increased demand for fertilizer. In addition, certain American Conservation Program payments have been made to farmers on a direct reimbursement basis for tertilizer purchased for pastures and other close growing crops.

More farmers throughout the nation are fertilizing more crops, using higher rates of application. The trend has been toward more use of

John H. Lister, Cooperative Manufacture and Distribution of Fertilizer by Small Regional Dry-Mix Plants, USDA Circular No. C-126, June 1941.

fertilizers on hay, pasture and cover crops. Yet there remains a tremendous acreage of these crops which is not fertilized and even most of those acres that are fertilized receive very small amounts per acre in comparison to college recommendations.

One of the more important factors contributing to efficient and expanded use of fertilizers over the past few years, especially on soil-conserving crops, has been the bringing together of fertilizer manufactures, distributors and dealers, with the public agricultural agencies, in developing educational programs involving manufacture, distribution, and use of fertilizers. The TVA fertilizer distributor-demonstration and farm test-demonstration programs, and TVA fertilizers have made important contributions in this respect.

Contrary to what one might expect, the price of fertilizer has increased less relatively than most of the other inputs farmers use. The U.S. Department of Agriculture has estimated that while the cost of all fertilizers, based on 1935-39 prices increased 48 per cent, feed prices increased 100 per cent, farm machinery 116 per cent, and wage rates 346 per cent.<sup>8</sup> It appears, therefore, that one of the principal reasons for the increased demand for fertilizer has been its relative improvement, from the farmer's viewpoint, as a cost of production item.

In the past, much of the mixing, wholesaling, and retailing has been built on a high volume, low margin basis. The internal and external economies inherent in operation of large mixing plants in some instances and the economies of distribution in intensive fertilizer use areas may result in fewer handlers, each doing more business than at present. This should assist in further lowering costs of fertilizers to farmers. Improved methods of handling, such as in bulk or in the convenient liquid and gaseous forms, will also contribute to this general improvement in the economies of distribution.

One innovation which may have revolutionary consequences for the industry is the soil test. As a result of the use of this objective determination of the soil's need for plant nutrients, many more ratios of plant nutrients than are now available may be needed in varying quantities in a mixing plant's marketing area. Several marketing schemes are being employed in various locations at the present time to meet this new type demand. Fundamentally, each method depends on the use of straight materials mixed in the local area to the ratio prescribed by the soil test. Three methods being employed are bulk-blending, including prescription mixing, multiple hopper fertilizer spreader use, and liquid mixing. Each of these new marketing techniques reduces the cost of mixing, and makes it less necessary to use additives which contribute little to fertility,

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<sup>&</sup>lt;sup>8</sup> Computed from The Farm Cost Situation, USDA, November 1957.

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but add weight which leads to additional freight, handling, and storage costs. A central feature of these innovations in fertilizer marketing is custom spreading. Because the spreading machines designed to handle three straight materials simultaneously are more costly than conventional machines, it is usually necessary to fertilize more acres annually than are available on single farms in order to secure efficient cost of operation.9 In Illinois where bulk-blending is now being done in 92 small plants, 27 per cent of the total straight materials was handled by these mixers in 1956.10 Rapid growth in bulk blending has developed in Illinois and in other areas of the Midwest. If this segment of the industry continues to grow, a very great decentralization of mixing operations could occur. With such a development, market structure might be altered considerably with perhaps an improved ability on the part of industry to meet the specific plant nutrient needs of each field on each farm. If this activity is to expand significantly, it may have to overcome some important problems such as securing and maintaining uniform mixtures, and modifying the present seasonal demand for the spreading service.

#### Research Programs

Another innovation which indirectly affects changes in market structure is the improved knowledge of economical fertilizer use through research. During the last decade marked improvements in agronomic research relative to fertilizer use and economic interpretation of the agronomic data have been made. 11 Now, instead of investigating the effects of single plant nutrient increases or decreases on crop production, researchers design their experiments so that various combinations of applied plant nutrients are tested simultaneously. Findings from these studies have armed agricultural workers, fertilizer company fieldmen, and others with the basis for making more sound fertilizer recommendations conditioned by relevant economic factors. These developments and others are focusing farmers' attention on the price of plant nutrients they buy to a greater extent than formerly. We have attempted to indicate and explain briefly some of the major changes that have occurred in the fertilizer industry and in the demand for fertilizers during the last three decades. It is our hope that more research workers will undertake studies of specific problems related to the fertilizer marketing structure with the

<sup>&</sup>lt;sup>8</sup> Harold G. Walkup, Economic Considerations in the Use of 3-Hopper Fertilizer Spreaders in Kentucky, Knoxville, Tennessee Valley Authority (In Press).

<sup>&</sup>quot;B. J. Bond and Earl R. Swanson, A Cost Analysis of Fertilizer Bulk-Blending Plants, The University of Illinois in Cooperation with TVA (In Press).

<sup>&</sup>lt;sup>11</sup>E. L. Baum, Earl O. Heady, and John Blackmore, Methodological Procedures in the Economic Analysis of Fertilizer Use Data, 1955; and E. L. Baum, Earl O. Heady, John T. Pesek, and Clifford Hildreth, Economic and Technical Analysis of Fertilizer Innovations and Resource Use, Ames: Iowa State College Press, 1956.

objectives of (1) securing a better understanding of this industry, and (2) determining efficiencies in the marketing system that may be effected so that farmers may be able to secure plant nutrients at lower cost per unit, yet maintain a strong and expanding fertilizer industry.

# DISCUSSION: THE CHANGING STRUCTURE OF THE FERTILIZER INDUSTRY IN THE UNITED SATES

CALVIN R. BERRY University of Arkansas

Baum and Clement have largely restricted themselves to a discussion of the historical development of the various sectors of the American fertilizer industry. It is extremely difficult to adequately treat such a broad and complex subject as this in the time allotted to it. These men have done a commendable job. Hence, my comments on their paper will be primarily supplementary rather than critical. Since Baum and Clement did not touch upon the portion of the industry between the fertilizer mixing sector and the fertilizer dealer, I will devote my discussion to changes in this segement as it relates to the behavior of wholesale prices of mixed fertilizer.<sup>1</sup>

The distribution sector of the fertilizer industry has undergone changes in recent years which have had far reaching effects on the pricing and marketing of fertilizer. Historically, fertilizer was retailed largely through business establishments where other farm supplies were sold, or where farmers sold their products. In recent years, however, these conventional outlets have been bypassed in an increasing number of cases as manufacturers have sold directly to farmers.

This practice of direct selling by manufacturers to farmers is not new, nor is this practice found only in the fertilizer industry. For many years, certain farmers have bypassed the conventional dealers in buying their fertilizer, seed corn and similar farm supplies. However, the practice of direct selling of fertilizer has reached much greater proportions in the past four or five years than ever before. While such factors as improved transportation and communication facilities, the increased number of farm trucks, and the efforts of farmers to reduce production costs have contributed to this change, the most important factor in explaining this transition lies in the market behavior of fertilizer manufacturers.

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<sup>&</sup>lt;sup>1</sup> Observations presented here are based largely on, and are more fully developed by Calvin R. Berry, "An Economic Analysis of Fertilizer Marketing and Pricing With Particular Reference to Indiana," unpublished Doctor's Thesis, Purdue University, January, 1958.

Following World War II, and prior to the end of the Korean conflict, fertilizer manufacturers experienced little difficulty in selling the entire product for which they had facilities and materials to produce. Faced with an expanding demand for fertilizer and being somewhat restrained in their output by relatively limited production facilities and temporary shortages of certain raw materials (notably nitrates), some fertilizer manufacturers even found it necessary to ration many fertilizer analyses to their dealers. While some fertilizer was distributed through farmerdealers during this period, most fertilizer was sold through conventional dealers. Following the end of the Korean conflict, fertilizer materials became more plentiful. During this same period, facilities for producing these materials were also expanded. Given an increasing demand for fertilizer and an abundance of raw materials, mixed fertilizer manufacturers expanded the number and capacity of their plants. Also, as a means of increasing the extent of their sales, many manufacturers resorted to direct selling to truckers and farmer-dealers.

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It has been alleged by both conventional fertilizer dealers and fertilizer manufacturers that, in general, both farmer-dealers and trucker-dealers have been willing to sell on extremely low profit margins, due to low overhead operating expenses and conflicting interests, even to the point of selling at wholesale cost. Faced with such competition, conventional fertilizer dealers have demanded price reductions in the form of discounts from their suppliers. While some manufacturers attributed a large share of their price difficulties to the effect of these "low-margin" dealers, there was rather wide agreement in the industry that direct selling would continue, at least in the foreseeable future, due to the current plentiful supply of fertilizer and the existance of excess production capacity in the industry.

Due to the close similarity between the products of different manufacturers of mixed fertilizers and the fact that a rather small number of producers control a major share of the total supply of the product in many market areas, a close interdependence in product pricing and other market behavior exists among the members of the industry.

There is a high degree of uniformity in the wholesale prices quoted by fertilizer manufacturers within a given market area. However, the final cost to dealers may be quite different due to the varied nature and form of discounts and allowances which prevail in the industry. Not only are differences found in the discount policies of various manufacturers, differences also exist in the discounts offered by the same manufacturer. However, there are certain allowances which are standard in the trade. Transportation allowances, preseason discounts and price reductions for prompt payment are largely the same for all mixed fertilizer producers

and can be justified on the basis of cost reductions to manufacturers. It is largely through the effect of a rather involved system of competitive adjustments at the dealer level that difference in wholesale fertilizer prices arise. For lack of a better term, these competitive adjustments may be called "compensatory discounts" since they were used to compensate for differences in competition between dealer sales areas.

Most manufacturers reported that their fertilizer price lists were made up on a "cost-plus" basis, after due consideration of the proposed prices of other fertilizer producers. It was generally agreed, however, that in recent years these price lists have often served as little more than a basing point for subsequent price adjustments through compensatory discounts. In general, the decision to grant a discount, as well as the amount of the discount, was governed by the competitive situation in the individual dealer sales area, the size and importance of the individual dealer's sales relative to the total sales of the manufacturer in that area and, in some cases, the type of dealer concerned.

The prevalence of compensatory discounts, price cutting and direct selling in the mixed fertilizer industry in recent years is indicative of the high degree of disorganization which currently exists in the industry and the imperfect nature of the fertilizer market. It also indicates a high degree of independent action on the part of mixed fertilizer producers. The threat of price wars is always present where such conditions of both close interdependence and independent action of industry members exist. During periods of limited availability of basic raw materials and restricted production relative to existing demand price wars are unlikely to develop since producers can easily sell their entire product without varying their market offer. However, given abundant supplies of raw materials and the existing capacity to produce for an expanding market, the possibility of price wars will again emerge. In an effort to expand their market, individual manufacturers may lower the price of their product and/or resort to direct selling and compensatory discounts. Other sellers through similar motives and measurers, or in retaliation in defense of their markets, may trigger a downward spiral of price adjustments which may continue throughout the fertilizer season. This is seemingly the pattern of events which have occurred in the mixed fertilizer industry in recent years. What the future course of events will be is uncertain. Manufacturers may conclude from their past experiences with price reductions that a restriction of such activities is to their common interest and may offer greater resistance to price reducing practices. However, so long as excess production capacity continues to exist in the industry, it is improbable that such attempts to stabilize prices will meet with success.

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#### THE CHANGING STRUCTURE OF MARKETS FOR COMMERCIAL FEEDS\*

V. JOHN BRENSIKE
Agricultural Marketing Service, USDA

A DISCUSSION of the changing structure of markets for commercial feeds requires first of all some mention of changes in the industry with at least implied trend or outlook information. Secondly, it requires a definition of the market structure. For the purpose of this paper market structure is defined as the changing practices, methods, and market conditions which may affect farm prices, income, and cost. The market structure also includes the degree to which demands of feeders are met.

Such a definition opens a wide area for discussion, but it seems appropriate that this paper consider these changes not merely for descrip-

tive purposes but as a setting for market price analyses.

Commercial feeds in this paper are identical with "formula" feeds. The formula feeds industry is relatively easy to define, but it is difficult to obtain statistical information to fit the definition. The industry includes all firms manufacturing and merchandising mixed feeds which are prepared to meet prescribed standards for the licensed trade name or brand. Thus, custom feeds and markets for grain and other ingredients will be considered in this paper only in their relation to the market structure for formula feeds.

## Background of the Industry

During early years, feed was marketed primarily through local grain elevators. These local elevators, frequently owned and operated by flour mills, supplied the milling industry with grain and received the byproducts in return to be sold as feed. Sometime after the turn of the century the industry began to mix other products with the grain and by-products to produce specialized rations and diversified feeds. Today most of these formulas contain between 15 and 25 ingredients, microingredients and drugs.

The industry as we know it today was created by and grew largely as a result of research. The research showed how the production of poultry, livestock, and their products can be increased per unit of feed by the addition of certain ingredients, microingredients, vitamins, antibiotics, hormones, and coccidiostats. The formula feed industry can continue to grow only by supplying even more efficient feeds and necessary related

services to the farmer.

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<sup>&</sup>lt;sup>6</sup> The author wishes to acknowledge the assistance given by members of the Market Organization and Costs branch in organizing the paper and offering constructive criticism.

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In seeking to achieve these general objectives and to obtain a share of the industry's rapidly expanding volume, each company tends to adapt itself to the conditions affecting its operations. Some operators seek to retain terminal market locations, others to emphasize decentralized locations. Some manufacturers emphasize the mixing and sale of complete feeds and others the mixing and sale of supplements and concentrates. This latter operation makes it possible for relatively simple stationary or mobile custom mills and farm units to mix adequate feeds even with the advent of micro-ingredients and drugs which require more complicated mixing equipment. And indications are that some of the large plants are not achieving large enough economies of scale in production to offset the economy of procurement and service in medium volume plants. On the other hand, some of the methods of bulk handling and automation may make it efficient to operate large plants in certain locations by shifting production of major brands to terminal markets.

Not much is known about the force or permanence of these different types of operation, but general acceptance of any one of them could greatly influence the structure of the industry. Until recently, companies operating with any of these organizational plans have found it possible to increase their operations in this rapidly expanding industry. As a result, few industry patterns predominate.

## Industry Growth

Growth of the industry has been especially rapid since 1939. Value of shipments of prepared animal feeds increased 416 per cent between 1939 and 1954, according to the industry classification of the Bureau of the Census. Tonnage estimates for 1947 and 1954 indicate a growth of 40 per cent. An analysis of the data contained in Table 1 discloses three apparent industry developments:

- (1) The number of establishments in the industry doubled between 1939 and 1947 and then decreased between 1947 and 1954.
- (2) The number of production workers increased more rapidly than other employees between 1939 and 1947. This situation was reversed between 1947 and 1954.
- (3) The average plant volume appears to have been increasing.

This trend toward increased plant size was primarily the result of smaller plants shifting out of the prepared animal feeds industry. Industry opinion<sup>1</sup> and plant building announcements indicate that new plants are tending toward lower capacities, possibly half the size of earlier terminal

<sup>&</sup>lt;sup>1</sup> For example, "Another related trend in recent years has been the building of feed manufacturing plants of relatively smaller size than the large terminal mills; ...," article in *Feedstuffs*, September 8, 1956, p. 44.

Table 1. Prepared Animal Feeds Industry: Establishments, Employees, Value Added and Shipped for Select Census Years<sup>1</sup>

	Establish-	Emp	loyees	Value		
Year	ments	All	Production	Added	Shipments	
927	Number	Number	Number	\$1,000	\$1,000	
	447	11,378	7,632	55,117	299,793	
35	942	15,427	11,606	58,040	288,662	
	1,383	24,177	15,401	99,240	401,880	
939	2,688	55,152	40,115	393,049	2,112,241	
947	2,292	59,890	41,290	584,135	2,702,267	

<sup>1</sup> Census of Manufacturers, Bulletin MC-20D, Grain-Mill Products.

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plant construction. Average plant size is, nevertheless, increasing, since these new plants are still larger than the industry average and some of the small and medium plants have striven for and apparently achieved larger volumes.

A smaller number of plants in the prepared animal feeds industry does not necessarily mean that there are fewer plants mixing formula feeds or that the tonnage of feed produced in these plants has decreased. It means only that their method of operation has changed, causing the plant to be shifted to another classification of manufacturing or to be grouped with retailing or wholesaling organizations. Few plants have actually closed in the industry. Rather, these small plants have tended to pick up new sidelines, or an old sideline has become the major department.

The prepared animal feeds industry accounted for about 70 per cent of the total formula feeds produced in 1947 and 1954, according to industry estimates based on actual reports covering over 50 per cent of the total volume. In addition formula feeds are produced as secondary products in the flour and meal, soybean oil, meat packing, and cereal foods industries. According to the census, these industries accounted for approximately 10 per cent of the total formula feed in 1947 and 1954. Thus, possibly 20 per cent of the formula feeds are produced in what the census classifies as wholesale and retail establishments. These annual estimates by the American Feed Manufacturers' association also indicate another trend which cannot be noted directly in census data: the rapid industry growth in total volume has temporarily stabilized at about 36 million tons annually during the past four years.

#### Decentralization and Demand Orientation

Another extremely important trend which has appeared during this period of rapid growth is decentralization and the demand orientation of manufacturing locations. As Table 2 shows, the number of establishments in the prepared animal feeds industry has decreased in all regions

Table 2. Prepared Animal Feeds Industry: Comparison of Establishments. AND EMPLOYEES BY REGIONS, 1947 AND 19541

	Establishments			All Employees		Production Workers	
Regions		19	1954				
	1947	Total	20 or more em- ployees	1947	1954	1947	1954
N. al. B. A	Number	Number	Number	Number	Number	Number	Numbe
North Eastern Middle Atlantic	65 378	47 269	26	1,870	1,710	1,435	1,288
Eastern North Central.	551	400	70 108	8,290	7,350	6,104	5,055
Western North Central.	694	493	136	$11,640 \\ 10,061$	11,028 12,548	7,219	7,626
South Atlantic	234	313	98	5,732	7,513	7,486 4,417	8,663
Eastern South Central	110	175	47	4,173	4,570	3,322	5,111
Western South Central.	207	232	88	5,175	6,766	4,038	3,290
Mountain	141	116	27	1,758	1,873	1,464	4,565 1,318
Pacific	309	247	85	6,452	6,525	4,781	4,370
United States	2,689	2,299	685	55,347	59,890	40,266	41,290

<sup>1</sup> 1954 Census of Manufacturers, Bulletin MC-20D, Grain-Mill Products.

of the country except for the South Atlantic, East South Central and West South Central regions. In these regions the number of establish. ments increased 31 per cent between 1947 and 1954. The decrease in the number of establishments in the other areas was especially marked in sur-

plus feed producing States.

In the regions where most new plants were being built, the number of production workers per plant decreased 21 per cent from 1947 to 1954 as compared with a 20 per cent increase for the entire industry. An earlier study of production manhours per ton had shown that labor inputs were much higher per ton of feed produced in the South. When wage rates were considered, costs in the various areas of the country balanced out uniformly. Capital investments in new plants in the South appear to be bringing the production labor requirements into approximate equilibrium

This industry move towards the southern regions is the most noteworthy example of decentralization and demand orientation of formula feed manufacturing, but these changes have been occurring throughout the country. Early industry location was oriented toward flour mills and elevators, terminal markets, and feed surplus areas. Large plants located in terminal and other key positions in Pennsylvania, Ohio, Illinois, and Missouri mixed much of the formula feed consumed in the New England, Del Mar-Va, and southern regions.

The move toward decentralization and demand orientation of feed manufacturing appears to result primarily from: (1) the growth of de-

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mand in certain areas; (2) the demand for services and the growth of service competition; (3) some advantages in transportation costs;<sup>2</sup> and (4) the absence of effective economies of scale in production, once an annual volume of about 30,000 tons per year is achieved.<sup>3</sup>

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In view of these fundamental factors it appears that the over-all trend toward decentralization and demand orientation of manufacturing will continue unless the industry changes considerably. The extent to which this trend may advance is not as certain. There are some members of the industry who believe that because of the many ramifications of the feed manufacturing industry and the number of ingredients and types of feed desired any efforts outside of complete mixing units properly located may he stop-gap measures. With producers demanding more on the spot service, this may be the only answer at this time.4 A case study conducted at Iowa State College under contract with the U.S. Department of Agriculture's indicates that an efficiently operated combination of manufacturing and retailing in a feed surplus area, such as Iowa, saves enough in procurement and retailing costs to be more efficient than (1) organizations which mix complete feeds for shipment to retailers, (2) organizations which prepare mixing concentrates for mixing and sale by retailers, and (3) organizations which prepare premixes of microingredients for shipment, final mixing, and sale.

#### Competition

Most firms in the industry believe they cannot compete unless they offer most items of feed and services that their competitors offer. This belief is so strong that many plants increase operating costs by offering bulk deliveries, for example, before any quantity savings can be achieved. They do so at the expense of increased bagging costs per unit by shifting large volume sales to bulk. They also produce and warehouse about 80 different formulas, in mash, pellets and crumbles, and in many sizes of bags. Altogether they may total 130 different items. Naturally only a few of these items are volume sellers. It appears that about 10 per cent of the formulas account for 65 per cent of each firm's volume. Such a large

<sup>&</sup>lt;sup>1</sup>G. B. Rogers and H. C. Woodworth, *Distributing and Handling Grain-Feeds in New Hampshire*, Station Bulletin 426, University of New Hampshire, July 1956.

<sup>&</sup>lt;sup>4</sup>V. J. Brensike and W. R. Askew, Costs of Operating Selected Feed Mills, Marketing Research Report No. 79, USDA, February 1955.

<sup>&#</sup>x27;Don Koivisto, "Keeping Pace with Feed Distribution Changes," Feed Age, February 1958.

Unpublished report by Iowa State College under contract with USDA.

G. B. Rogers and H. C. Woodworth, op. cit.

<sup>&#</sup>x27;A linear programming analysis disclosed that sales and production costs can be reduced considerably by closing out certain formulas. P. T. Scott, "Application of Linear Programming for Profit Maximization in the Feed Firm," Thesis, Doctor of Philosophy, Iowa State College, 1957.

number of feed varieties and items is considered necessary because of the large number of ingredients (particularly the special purpose microingredients), the different opinions as to correct requirements for efficient

livestock and poultry production, and advertising.

An analysis of horizontal integration in the production of commercial feed appears to reflect some of the previously mentioned shifts from the elevator and flour industry, and the growth of some other major firms in the feed industry. In 1935 the four largest companies accounted for 23 per cent of the industry shipments, 19 per cent in 1947, and 21 per cent in 1954. The 20 largest companies respresented 40 per cent of the industry value of shipments in 1947 and 43 per cent in 1954.8 This is not a great degree of concentration when compared with other industries and permits considerable competition.

Competition among retail feed outlets is much greater than among manufacturers. The retail feed business is characterized by many competing firms operated primarily as small independent units. These retail units not only sell the branded feeds for other manufacturers but some of them perform the custom grinding and milling service for the farmerfeeder-mixing feeds to his specifications, using either the farmers' own grain or purchased grain, and mixing concentrates. They are normally only one department of a farm supply establishment or a country grain elevator. Not only is there competition between these firms but there is also a practice whereby manufacturers send their salesmen into retail territories and sell direct to feed users. There is virtually no integration through direct ownership among these retail outlets. This relatively low level of horizontal integration among manufacturing concerns and the virtual nonexistence of ownership integration among retail outlets, however, cannot be assumed for the future. As other industries have matured, many have turned to integration.

In some ways the lack of ownership integration at the retail level is misleading since many of the retail outlets or dealers are owned by manufacturers or tied by a legal contract to operate their formula feed department according to conditions prescribed by the manufacturers.9 Furthermore, selling prices are generally fixed by the manufacturer through

periodic price lists and other suggested markups over cost.

However, the retailer is usually left to decide on special quantity rates, bids to institutions, delivery charges or discounts for pickups, cash discounts, discounts for bulk purchases, and credit rules and charges. Some

<sup>8</sup> U.S. Senate, Concentration in American Industry, 85th Congress, 1st Session,

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Subcommittee on Antitrust and Monopoly.

\*H. H. Bakken, C. Bright, and M. Khalil, Retail Feed Distribution in Wisconsin, Central Retail Feed Association, Milwaukee 3, Wisconsin.

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of the problems faced by these retail outlets can be noted from the following information obtained in a New Hampshire study. A majority of the New Hampshire retail outlets are tied to the distribution organizations of firms supplying more than one outlet in the state. Fifty-four per cent of these retail outlets handle less than 2,000 tons of feed per year. Eighty-five per cent of the feed must be delivered to farmers with 77 per cent of the farms using 10 bags or less per stop and representing in total only 18 per cent of the outlets' volume. About 72 per cent of the farms received weekly deliveries and 21 per cent biweekly deliveries. A Wisconsin study indicated similar types of operations.

The industry also prepares special mixes, often gives "free" feeding and production advice, and contracts for meat and egg production. This is in addition to services such as delivery, including second and third story unloading; credit, including "free" credit for a specific number of days; the availability of a large variety of formulas and preparation in bulk and different bag sizes which have been mentioned earlier.

Each of these services is in many cases "free." Actually, all or most of them result in overhead costs which, if no direct charge is levied, must be borne by the user and nonuser alike. However, they often cost the producers less than it would cost to have the work done. They also bring to the producer skills and information he doesn't possess and frequently couldn't afford. Almost all companies engage in service work of this type to some extent. Some are offered exclusively by the retail outlet, some by the retailer after training by the field staff of the manufacturer, and others directly by the manufacturer's field staff, sometimes with retail help.

Price competition appears to be secondary to service or nonprice competition. To some extent this nonprice competition may have been sought by the industry through advertising and use of brand names, but primarily it appears to be the result of (1) rapid nutritional advances resulting in a wide range of opinions about what constitutes the most efficient producing formulas, and (2) the availability of many alternative and special purpose ingredients.

Manufacturers of ingredients, premixes and mixing supplements and concentrates advertise heavily the value of their ingredients or partial mixes and suggest complete formulas. The manufacturers of complete feeds advertise the use of their brands for best performance. Nutritionists in the U.S. Department of Agriculture and their counterparts in the experimental stations, and the extension services, whose research and edu-

<sup>&</sup>lt;sup>19</sup> G. B. Rogers and H. C. Woodworth, *Distributing and Handling Grain-Feeds in New Hampshire*, Station Bulletin 427, University of New Hampshire, July 1956.
<sup>11</sup> H. H. Bakken, et al., op. cit.

cational work helped build the industry, also recommend specific and changing formulas. To top it off, each farmer is a nutritionist, much as each man on the street is an economist.

With the wide variety of ingredients and the widely different and changing views on formulas, the emphasis on "performance" and "know your brand" seems automatic even if complete ingredient data were listed on the tag.12 Usually, however, only some major items such as protein, fat, drug and urea contents, and some maximums for salt, calcium, and fiber are required by state licensing agencies. The slow process of record keeping for feeder production is the only means available to check the relative feed quality, other than experience gained from using specific brands with constant feeding values. Some companies say that they maintain constant quantities of the various ingredients in each brand, others say they vary the proportion of the ingredients within a given analysis to give customers the benefit of the lowest alternative ingredient cost. In this connection, some of the work of the Department of Agriculture and Pennsylvania State University on least-cost ingredient formulas which will meet prescribed requirements may help to set a price and quality standard for research analyses.13

In addition to specific brand information most companies have two or possibly three price or band lines. Whether they are called low-priced feeds, quality feeds, high-priced feeds, utility feeds, high-energy feeds, or high-efficiency feeds, each term is applied from the viewpoint of the

individual company.

Vertical Integration

No analysis of the structure of the commercial feeds industry would be complete without at least mentioning vertical integration. The expansion of vertical integration from the broiler industry into the hog and cattle industries, if it occurs, could have a widespread influence on the structure of the commercial feeds industry, especially if the feed industry takes an active part in the integration. Retail feed outlets as we know them could largely disappear. Those remaining might handle only the slower moving items, losing the one, two, or three large accounts representing as much as 50 per cent of their annual volume.

Sales and advertising techniques and expenditures could change immensely and decrease in size. Emphasis would shift to farm production advisers, record keeping staffs, and banking and credit facilities. The

12 R. F. Hutton, G. A. King, and R. V. Boucher, A Least-Cost Broiler Feed

Formula, Production Research Report No. 20, USDA, May 1958.

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<sup>&</sup>lt;sup>12</sup> Open formulas appear to be primarily a sales method until all formulas follow this practice. If all formulas were "open" it would permit somewhat more price competition, but as long as there are widely divergent opinions about what constitutes an efficient formula and a large number of different formulas is available, price competition cannot become truly effective.

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geographic location of the industry also could shift along with any shift in livestock production and feeding. Much of the volume of formula feeds would skip the feed pricing mechanism and the remaining formula feed could take on many of the aspects of joint product cost and pricing. Only the production operation would remain relatively stable, and even this could become more of an assembly line operation as the major items increased in volume and the other items were dropped.

Concentration of production could increase rapidly in the industry if sales were directly tied in with the availability of loanable funds.

The major reason the feed industry could become active in an integration operation of this type is that the industry realizes that it is selling to a different farmer than it was 10 years ago. Much of the feed is now moving to the big farms operated by the agricultural businessman who has a large capital investment and needs long term credit. Another extremely important reason is that excess capacity exists in the industry and the size of the market has stopped increasing at its recent rapid rate.

The potential ability of the feed industry to play a part in the integration of the hog and livestock industry will be studied by the U.S. Department of Agriculture under contract with Iowa State College. Some information as to potential changes in the marketing structure of the industry which could occur as a result of increased integration will also result from this analysis.

#### Recession

I should at least raise the question as to what will happen to the structure of the industry if general economic conditions and especially the farm economy trend toward depression levels. Certainly this paper has assumed a continuation of the relatively prosperous conditions that have prevailed. By prosperous conditions I mean that farmer feeders have had sufficient liquid capital to finance production through purchases of supplies and equipment. Should capital become more stringent farmers may retrench in ways that could have a direct bearing on the structure of the formula feeds industry. With a change of this type, custom milling could become more important in surplus grain areas, surplus capacity could increase, price competition could become more important and service competition decline, and the number of formulas could become more standard. Horizontal and vertical integration could be influenced considerably, although the direction of influence is difficult to determine.

#### Needed Research

Much, in fact most, of the needed research was implied in the preceding part of the paper. For example, the references to the recent rapid

<sup>&</sup>lt;sup>14</sup>H. C. Trelogan, a paper presented before 1957 Midwest Feed Production School, Kansas City, November 19, 1957.

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growth coupled with the relative stability of output in recent years, imply that the industry is maturing and that industry organization and practices may begin to show more over-all industry patterns. Certainly, people in the industry have become much more concerned about their distribution organizations and whether their organizations are going along with the probable industry wide trend. Research people need to have more facts about these trends and their influence on the market structure and efficiency.

The number of references to the New Hampshire and Wisconsin studies also implies the need for current status analyses of retailing and the relations between retailer and manufacturer in other areas of the country. Even more important, however, is our need to know more about the feeders' reactions, opinions, and preferences for the type of feed and

services made available by the commercial feed industry.

A review of the statements made on price, service, and quality competition discloses the need for much more work in this area. Data are scarce and the need great. The U.S. Department of Agriculture reports on prices paid by farmers and the wholesale level for formula feeds must eventually be obtained for somewhat more specific types and qualities of feed. At present they represent average prices for the largest selling brand of feed, with no indications of quality or quality changes except for the specification of protein content in dairy feeds. Ingredient costs are incomplete for many of today's feeds and geographic coverage is incomplete and somewhat outdated. In this connection we need to know more about the movement of each ingredient and its basing points.

Not much price analysis can be conducted until it becomes possible to relate quality to price. Quality, however, cannot become uniform until opinions about the number of ingredients and microingredients, and the efficient feed for a specific purpose are stabilized. Completely open for-

mulas would help but would still not be the entire answer.

A knowledge of elasticities of demand for the major types of formula feed such as poultry, dairy, and hog, especially those relating to changes in poultry and livestock prices and income, would help considerably in planning for and anticipating some of the structural changes in the industry. Data on price elasticities of demand for individual ingredients in each of these types of formula feed also are needed. Some of this latter type of analysis may result from or be an added feature of the current analysis of least-cost formulas.

In conclusion, more attention must be paid to potential and occurring trends in integration (both horizontal and vertical) and poultry and live-stock production. The potential influence of these trends can be noted from the shifts in the industry structure which occurred partially as a result of integration and geographic shifts in the broiler industry.

# DISCUSSION: THE CHANGING STRUCTURE OF MARKETS FOR COMMERCIAL FEEDS

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ROBERT W. SCHOEFF Central Soya Company, Inc., Ft. Wayne, Indiana

The commercial feed industry plays a vital role in the production and distribution miracle of food that has been appropriately named "Foodpower . . . U. S. A." "Foodpower through Feedpower" is a slogan we like to use in the feed industry. With fewer United States farmers on larger farms, working fewer hours, and constantly increasing egg, milk, and meat production, it is most appropriate to discuss the changing structure of markets for commercial feeds.

Brensike's definition of market structure for commercial feeds is quite general and appears to include the farm market structure.

We in the feed industry think of market structure for commercial feeds in terms of: (1) consumers or farmers; (2) retailers or feed dealers; (3) wholesalers; (4) manufacturers; (5) suppliers of feed ingredients.

It is not easy to describe an industry so large and complex as the commercial feed industry, particularly when there is a real shortage of good industry data. Brensike has pointed out many of the changes that have taken place along with possible changes for the future, all of which are good food for thought.

### Industry Growth

According to the annual estimates made by the American Feed Manufacturers' Association (AFMA) commercial feed sales have temporarily stabilized at about 36 million tons. One of the principal factors contributing to this leveling off of sales has been the tremendous increase in the efficiency of commercial feeds requiring less feed per pound of gain. The AFMA recently released a report showing feed sales in the first six months of 1958 to be 9 per cent above the same period a year ago. It appears that industry sales will show a nice increase for the year and resume their upward trend.

With no allowance for changes in the per capita consumption, the production of eggs, meat, and milk must be increased at least another 25 per cent by 1975, just to meet the expected increase in United States population. The sale of commercial feeds is expected to increase, though not exactly by the same per cent.

The feed industry is a growing industry as evidenced by the building of many new plants. Feed plants built since 1954 have a production capacity in excess of one million tons.

#### Decentralization

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A key factor contributing to the trend toward decentralization has been the shift from rail to truck distribution of feed from the manufacturing plant. Water transportation is playing an important part in the expansion of the poultry and livestock industry in the South. Water transportation offers tremendous savings in the movement of surplus soybeans and corn from the upper Mississippi area into the Georgia-Alabama feed deficit area. Some of the more aggressive railroads are awakening to the loss of business to barge and truck lines. For example, on December 31, 1957, the Southern and the Central of Georgia Railroads reduced their rate on soybean meal and grain from Chattanooga, Tennessee, to Gainesville, Georgia, by \$2.80 per ton.¹ This meant a direct saving in the manufacturing cost of a complete broiler feed of approximately \$2.25 per ton.

Brensike's statement that a study by Iowa State College indicated a combination manufacturer-retailer to be the most efficient way to get commercial feed to the farmer prompted me to secure a copy of this report. The data does indicate but does not prove that such a system is the best for the industry. Several assumptions made in this study can be challenged, and this is not the way the feed industry is operating in Iowa today. The words, "efficiently operated," are used and no matter what kind of a manufacturer-distributive system is used, if it is efficiently operated, it has every chance of succeeding in our free enterprise economy. Historically, as the small manufacturer-retailer becomes successful and starts to grow, he is immediately faced with the problems of managing additional plants and personnel and the raising of additional capital. The character of the business changes, jobs become specialized, and the company takes on all of the characteristics of a big business.

To my knowledge the private feed industry does not use a contract to bind a retail feed dealer to a manufacturer nor has such an instrument been used in recent years.

## Integration

Brensike states, "There is virtually no integration through direct ownership among retail outlets." This is a very broad statement and does not hold true for all areas in the country. In the New England area commercial feed companies own a substantial number of retail stores and there are several states in which the cooperative feed manufacturing plant is owned by local units or vice versa. A large Midwest cooperative appropriated \$2 million last year to acquire additional retail outlets because of its excess production capacity. Here again, the trend is mixed; several

<sup>1</sup> Grain Tariff, SFA 94B 764F.

<sup>&</sup>lt;sup>2</sup> Article in Feedstuffs, December 7, 1957.

of the larger manufacturers who opened retail stores as a means of expanding distribution during the 1930's and 1940's have been disposing of these units in recent years.

#### Recession and Research

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From the recent headlines in the newspapers it appears we should be more concerned about inflation than recession and certainly have little reason to be concerned about a decline to depression levels.

Brensike's statements on needed research within the commercial feed industry should receive careful consideration by those responsible for marketing research at the state universities and colleges and USDA.

To better know where the markets for commercial feed are and the changes that are taking place, the feed industry needs more detailed live-stock and poultry estimates than are now available. Annual broiler production by counties in the 22 leading states is urgently needed. Average number of layers by counties for all states, and the extension of the quarterly pig crop report outside of the corn belt is also needed.

I would like to call your attention to other changes that have taken place in the markets for commercial feeds:

- 1. The shift from complete feeds to concentrates to complete feeds. (The feed industry started in the 1920's with the sale of complete feeds for livestock and poultry. During the depression years of the 1930's, concentrates were sold through feed dealers. Dealer service became a factor. Now, in the 1950's the trend is back toward complete feeds with even greater emphasis on dealer service since the feeders are becoming larger.)
- 2. Formulation of feeds for each stage of the life cycle.
- 3. Introduction of widespread use of pelleted and crumpled feeds.
- 4. Shift from distribution of feed in 100 lb. burlap to 50 lb. paper bags and, more recently, in bulk.
- 5. Use of major new ingredients like vitamins, hormones, antibiotics, and animal fats.
- 6. Use of credit to finance the expanding poultry and livestock industry.
- 7. Booking of feed by dealers for short periods of time and contracting of feed by feeders for three to six month periods.
- 8. Increased demand for specialty feeds with dog food leading in volume and fish food being one of the newest.

Many changes in the market structure for commercial feeds have taken place and one can forecast with some certainty that changes will be made in the future. With change comes market opportunities.

#### ADAPTING DATA TO NEW CONDITIONS

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Chairman: F. V. Waugh, Agricultural Marketing Service, USDA

#### AGRICULTURAL STATISTICS IN A CHANGING WORLD

O. V. WELLS
Agricultural Marketing Service, USDA

ET ME STATE our dilemma simply:

Statistics are not glamorous—a fact which makes their improvement difficult.

Yet statistics are essential to today's decision-making processes, both private and public—a fact which makes their improvement imperative.

It seems to me that these statements are generally true for statistics of almost any kind within the United States and so far as my observations have extended, for most other countries. However, the immediate subject is agricultural statistics, and I shall confine my remarks to U. S. agricultural statistics.

Some of us like to point out that the first legislative action implementing George Washington's suggestion for the establishment of an agricultural board "(composed of proper characters), charged with collecting and diffusing information" was an act "to promote the progress of the useful arts," approved March 3, 1839, appropriating a sum of money not exceeding \$1000 to be expended by the Commissioner of Patents in the collection of agricultural statistics, and for other agricultural purposes. We are also aware that the acreage and yield series for several of our principal crops, as well as farm prices, trace back to 1866 while we have had a Census of Agriculture at least once every decade since 1840.

Over the 95 years that have elapsed since the first agricultural statistician was appointed under Abraham Lincoln, agricultural statistics have developed until there is a generally held belief today that agricultural data needs are being more nearly met than are those for any other leading economic group.

This view is mischievous and misleading. It confuses quantity with quality as indicated by the fact that our agricultural statistics more and more often fail to give us timely answers to the questions in which we are most interested. The world is changing. Not only is American agriculture going through a technological revolution; its management and decision-making processes are equally affected.

What we most need in agricultural statistics today are improvements in quality, not quantity.

With the increasing emphasis on size and scale of farm operations, on specification buying, on market timing, and on balancing supplies of farm

products with demand, we increasingly need more accurate and more timely data. Further, as our economic system becomes more and more complex, and as we develop new concepts as to how to maintain stability and encourage economic growth, we constantly need to revise or strengthen our statistics to fit the new conditions or new concepts. The simple fact is that general descriptive statistics are no longer sufficient.

Statistics are basic to farmers' decisions as to what to grow now or next season, as to when to buy or sell, as to whether to oppose or support collective action through cooperative or governmental channels—such statistics must be accurate or farmers find themselves out in the cold. Processors and the trade generally have also come to rely to a surprising extent on current statistical measures as a basis for any number of decisions, perhaps even more so than the farmers themselves. At the same time, government officials find their decisions dictated in large part by statistical facts—facts which had better be considered beforehand since they will inevitably have to be met and dealt with somewhere down the road.

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Kenneth Arrow expresses the argument for more and better statistics very well in *Econometrica*, October, 1957, when he says, "In view of the magnitude of an economic system, it would take only a very small percentage of improvement in economic stability or growth to make almost any conceivable data collection worthwhile" (i.e., the cost of collecting the relevant data would be quite small as compared with the possible gain). But there are practical limits: We must know what to collect, usually in advance, while at the same time fiscal administrators and legislative committees are rarely as enthusiastic about statistics as are the economists and the statisticians.

All too often, either because of pressing necessity or an eagerness to be useful, we make estimates on the basis of such data as are available even though it is recognized that the reliability or probable error of such statistics leave much to be desired. As the weight of actual decisions, whether large or small, private or public, comes to rest upon such statistics, we often find that they are not adequate. One of the unfortunate results is that most efforts to improve statistics come only as the errors become so large as to be easily recognizable. We should be able to do better.

There has been considerable concern as to the general acceptance of statistics by the public over the last decade as well as increased attention to the kind of statistics most needed. A considerable bit of this concern has had to do with agricultural statistics. Suppose we briefly review some of the recent literature, starting with the Task Force Report on Statistical Agencies, prepared by Frederick C. Mills and Clarence D.

Long for The Commission on Organization of the executive branch of the government (submitted January 1949).

In appraising the role of statistical intelligence in a modern society,

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Mills and Long indicated that:

"Recent statistical developments have been marked not merely by an increase in the number of reports and in the extent of their use. The character of the contribution made by statistics to government and to private administration has been profoundly modified within the last quarter century. Enumeration for purposes of historical study persists; the record of national life is contained in measurements of changes in population, production, wealth and other historical series. But in high degree the emphasis in the work of the statistician has shifted from this backward-looking process to current affairs and to proposed future operations and their consequences. Experiments are designed, samples selected, statistics collected and analyzed with reference to decisions that must be made, controls that must be exercised, judgments that entail action. The growth of the statistical services over the last several decades reflects this change in the function of statistics."

Their three general conclusions with respect to statistical activities in the federal government were:

(1) The collection and dissemination of information concerning the structure and processes of national life are among the basic functions of government.

(2) The statistical work of federal agencies can be improved with respect to quality of product, coverage, coordination of activities and results, and

economy of operation.

(3) Lines of systematic future development of the system of statistical intelligence must be laid down, if orderly growth and the meeting of con-

tinuing national needs are to be assured.

Perhaps it is also worth noting that Mills and Long visualized the tasks of collecting statistics as being divided between (a) various agencies gathering statistics as by-products of administrative or regulatory activities—i.e., Internal Revenue or the Federal Meat Inspection service; (b) a single agency (Bureau of the Census) serving the public and other agencies of government in repetitive and large-scale primary tasks; and (c) a small number of agencies collecting data in highly specialized subject matter fields (the agencies mentioned at the time were the Bureau of Agricultural Economics, the Bureau of Labor Statistics, the Bureau of Mines, various units of the Bureau of Foreign and Domestic Commerce, the Public Health service, and the board of governors of the Federal Reserve System). Obviously, such an arrangement calls for coordination rather than centralization, and Mills and Long recommended a strengthened Office of Statistical Standards and Services be maintained in the executive office of the President.

A second item is the report of the Committee on Farm Employment

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Estimates of the American Farm Economic Association (AFEA) (Proceedings issue, Journal of Farm Economics, December, 1953). This report recommends the elaboration and qualitative improvement of the farm labor estimates of the census and the Agricultural Marketing Service. In addition to indicating ways of obtaining more adequate monthly estimates of persons in the labor force, the Committee also wanted monthly estimates of the labor used in agriculture in such units as man-days or man-hours, by age, sex and employment categories. Such a program clearly visualizes more resources than were or are now available.

The next two items deal with statistical systems as a whole—one with the Crop and Livestock Reporting service of the Agricultural Marketing Service and the other with the agricultural censuses of the Bureau of the Census.

A special subcommittee of the Committee on Agriculture, House of Representatives, was established in 1952 "to study the cotton crop estimates of 1951 and related estimates, forecasts, and reports of the Crop Reporting Board of the Department of Agriculture." Actually, the subcommittee approached its task in a very constructive manner, looking as much at the crop and livestock estimating system as a whole as at the cotton estimating procedures used in 1951.

The subcommittee soon discovered that they were not dealing with a simple problem. As indicated in the foreword of their report, they "received a very small response to [a] general and widely publicized invitation for witnesses to appear at the hearings. Apparently, while a great many people have been dissatisfied from time to time at some of the reports issued by the Crop Reporting Board, there is a considerable reluctance on their part to come in and suggest how the reports might be improved."

The subcommittee discussed several steps for improving estimating methods, recommending among other things that "the Bureau of Agricultural Economics establish a unit devoted entirely to research, analysis, and experimentation directed at discovering the shortcomings in its present methods, and developing improvements therein." The subcommittee felt that chief emphasis should be placed on improving existing techniques as "modern methods of statistical sampling" might be too costly but also indicated that, "On the other hand, the committee is not satisfied with the present method or the results it produces." After discussing objective measures, enumerative techniques, and possible collaboration with the census, it was suggested that "A schedule of census enumerating might be worked out which would give the Crop Reporting Board valuable check data for crop estimates and at the same time, provide a continuous flow of agricultural census information to the Census Bureau which would be processed as it arrived and made available to the nation in a reasonably short time thereafter."

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Shortly following this study of the Crop Reporting service, the Secretary of Commerce asked a nine-man committee under the chairmanshin of Ralph J. Watkins, including the well-known agricultural economist. Murray R. Benedict, to appraise the several programs of the Census Bureau. With respect to agriculture, this report, released in February 1954, recommended that the full censuses of agriculture as authorized for the fall of 1954 and 1960 be taken (with the 1960 census also shifted to the fall if possible). This committee further recommended that "beginning in the decade of the 1950's the mid-decade census of agriculture be supplanted by a series of biennial sample censuses of agriculture to be taken for the crop years ending in 1, 3, 5, and 7, and by restricted sample surveys to be conducted for the years ending in 0, 2, 4, 6, and 8. The regular decennial census would cover the crop years ending in 9." The committee recognized that legislation would be required but estimated that the sample censuses would cost something less than the full mid-decade census they would supplant.

The Congressional Joint Committee on the Economic Report is much interested in statistical activities and a subcommittee on economic statistics was established in 1954. This subcommittee, in examining statistical gaps or deficiencies has been sympathetic to strengthening agricultural statistics, especially quality-wise. However, the committee has generally felt that statistical coverage for agriculture was better than for some other fields and this feeling is reflected in the "Program for Improving Federal Statistics in Fiscal Year 1959," carried as Appendix C to the "Economic Report of the President" sent to the Congress in January, 1958.

The suggestions in this economic report were specifically designed for strengthening the integrated national accounts, the system of statistics relating to national income and national product. These recommendations, however, do call for strengthened productivity estimates and for better construction statistics, both of which involve agriculture, and there is also a specific recommendation that "After the Census of Agriculture for 1959 is completed, an annual sample survey of farm operators should be initiated to provide data on farm income, off-farm income, and farm production expenditures. The sample should make possible estimates for at least three categories-large commercial farms, small commercial farms, and all other farms." Such surveys would substantially improve the adequacy and usefulness of our farm income material.

Another item of interest is the address by Raymond T. Bowman, Assistant Director for Statistical Standards, Bureau of the Budget, on "Improvement of Federal Statistics" (before Washington chapter of the American Statistical Association, January, 1957). Bowman indicates attention should be centered on the need for competent and well-trained percre-

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sonnel, the improvement of quality in the whole range of statistical processes, the importance of proper presentation or publication, and the need for greater integration of the federal statistical program. Bowman also comments:

"In the past few years the Department of Agriculture has instituted a program for the improvement of crop and livestock estimates by means of modern sampling methods. The program is still in the early stages, but the results to date are promising. In a way this activity typifies a new era in statistics. It employs modern techniques to produce better results, but beyond that it is creating a statistical framework within which a whole set of integrated agricultural statistics can be developed." (Italics supplied.)

The Agricultural Data committee of the AFEA also submitted a report in January, 1957. This committee had been asked to study the accuracy, availability, and needs of agricultural data for people in agriculture, business, research, teaching and government agencies. After two years of study, the committee suggested that the Bureau of the Census, the Crop Reporting Service, and the Federal Extension Service arrange to advise and train county and state extension workers in the use of such agricultural data as are currently available; that the Census Bureau and the Crop Reporting service determine to what extent the needs for more timely, complete and accurate agricultural data could be supplied within existing resources; that the Congress should sufficiently increase appropriations to supply the more urgent demands for timely, accurate and complete agricultural data collected and released by the U.S. Department of Agriculture; that further attention should be given to the census activity in connection with the preparation for the 1960 census and future censuses of agriculture; that state commissioners of agriculture, state statisticians, land-grant colleges, and others should improve ways of meeting data needs at state and county levels; and that the collection and publication of state and county agricultural data of importance to state and county people should be expanded so as to maximize local self-help.

The work of the Agricultural Data committee, as well as a long standing interest of the subcommittee on agricultural appropriations, House of Representatives, led Jamie L. Whitten, chairman of that subcommittee, to request a report from the U. S. Department of Agriculture on research in the agricultural estimating field as well as an outline of a program for the future development of the service. Such a report was submitted to the subcommittee in February, 1957.

This report summarized the results of research and developmental activities, indicating that new methods for improving estimating and forecasting work must necessarily meet the exacting time schedule necessary for providing a current reporting service, that the methods used must result in estimates for states as well as for the United States as a whole,

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and that the cost of the program should be as reasonable as possible commensurate with the degree of accuracy and the amount of detail required. Experimental enumeration of a representative sample of agricultural areas has demonstrated that this is practical and that it can be integrated with the mail questionnaire technique so as to hold costs down while at the same time mitigating the principal weaknesses inherent of the voluntary mail survey method. Objective measures of plant development during the crop season on sample fields also offer possibilities of more reliable estimates of yield.

Basically, the program proposed in the report of the subcommittee on agricultural appropriations divides itself into four steps:

The first and major step is in the nature of a capital outlay to provide the structure necessary for a substantial improvement in the whole crop and livestock estimating field. This calls for a basic organization which will allow the use of an enumerative sample covering some 60,000 to 75,000 farms, distributed so to be representative of the 48 states, to be enumerated completely each spring or early summer to obtain acreage of crops planted and livestock numbers, and partially enumerated each fall to obtain final acreage harvested, yields, and end-of-the-year livestock inventories. Mail inquiries would be improved and continued and a series of objective crop measurements on a large sample of representative fields for main crops during the growing season would be developed.

Basically, the proposal is to create a structure which would allow the objective determination of the acreage of crops planted and numbers of principal livestock in the spring or early summer, probably about mid-June, and which would also allow an adequate measure as to change in numbers and size of farms. That is, the first need is to provide a structure for substantially improving the reliability of the crop acreage, livestock number, and yield data which are most important.

The second step would provide for strengthening and improving the estimates of prices received and paid by farmers. The enumerators used under the first step could also carry a considerable part of this work although they would be working with businesses buying from or selling to farmers. There are some gaps in price data currently available and a great need for improving the sampling base and the precision of prices collected.

The *third step* has to do with speedier release and distribution of reports. This would require either more analysis of the data in the states or possibly the simplification and centralization of the computing task. The principal added expense would be for a communications system.

The fourth step covers additional data and services needed. Over the last several years especially there has been a substantial increase in the

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demand for what we call "market flow data"—that is, data which helps predict more adequately the flow of farm products to the market. Note, however, that supplying the additional data and services needed comes as a fourth step in this proposal rather than coming first as is ordinarily the case when statistical development waits until pressure for a particular service has developed.

So far the several items summarized have dealt almost altogether with the collection rather than the analysis of agricultural data. Mills and Long envisioned analysis by the agencies collecting primary data in specialized fields as well as by a small number of analytical agencies and advisory councils utilizing statistics collected and processed by other agencies.

There is certainly no reason for collecting data unless funds and facilities for analysis are also available. My attention has been called to the fact that any complete discussion of agricultural statistics in a changing world should clearly indicate that "we have not begun to really capitalize on the potential *practical* possibilities of many theoretical developments"—structural equations, linear programming, spatial equilibrium, interindustry matrixes, lagged responses, etc. Nevertheless, these developments have been and will continue to be discussed elsewhere. Remarks here are confined to the collection of basic data and to the main farm price and income measures.

The Joint Economic Committee in its recent hearings on the relationship of prices to economic stability and growth asked for a series of papers having to do with the measurement of price changes and price relationships (see compendium of papers submitted by panelists appearing before the Joint Economic Committee, released March 31, 1958).

In discussing price and income measures for American agriculture, I made a series of recommendations for revising and improving a number of the main indexes or aggregative measures which seemed to me were essential economic indicators in the agricultural area. Price measures discussed were the index of prices received by farmers, the index of prices and cost rates paid by farmers (the so-called "parity index"), measures of the costs and margins which intervene between farmers and consumers, and measures or indexes of farm real estate values. The leading recommendation was for shifting the base and weighting period for our price indexes and related measures to a post-World War II period.

With respect to farm income, it was suggested that we need (1) to strengthen our current farm income estimates wherever possible, especially the estimated income of farm people from nonfarm sources, (2) to substantially improve our estimates of farm production expenditures both by states and for the United States as a whole, and (3) to find ways of breaking down our annual farm income estimates as between classes of

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farms, especially commercial versus noncommercial farms. We also need adequate definitions and annual estimates of both farms and farm population. Supplementary series indicating the changes that are taking place with respect to different types of commercial farms are also desirable. The coverage of the costs and returns series for specific types of farms now maintained in the Farm Economics Research Division, Agricultural Research Service, should be substantially increased.

Substantial quality improvements in agricultural statistics are not

likely until some major breakthroughs are achieved.

There are three chief things which, it seems to me, are most needed: (1) Current crop and livestock estimating methods need to be supplemented by a series of regularly recurring, fast-moving, specifically oriented enumerative surveys of a sufficient number of sample areas to yield reliable state estimates for main crops and classes of livestock.

(2) Substantial use of enumerative techniques is required for agricultural prices, farm expenditures, and nonfarm income of farm people to

increase the precision and usefulness of such data.

(3) The bases for agricultural indexes generally, including the indexes of prices paid and prices received, need to be shifted to some selected

period subsequent to World War II.

Such actions could substantially improve the accuracy of the main crop and livestock estimates upon which the weight of a multitude of actual decisions depend—that is, the estimates which most often influence private decisions as to market prices, as to whether to hold or not hold stocks, as to what to plant or whether to feed or not feed livestock, etc., or decisions of governmental agencies as to whether or to what extent to take actions in connection with procurement, price support, surplus disposal, or marketing order activities. And I am equally convinced that this can be done without any loss in *timeliness*, provided the supplemental surveys are designed specifically and only to assist in the estimating job.

Such actions could substantially increase the accuracy and usefulness of the main economic indicators relating to agriculture. And finally, shifting the reference bases for the main indexes to a recent base would at one stroke solve a whole series of problems having to do with the chaining together of differently weighted indexes, the introduction of new items, the improvisation of backward-looking data from inadequate sources, etc., and allow attention to be centered directly upon the changes that most matter, those that are just past or are now in process.

There are some problems: funds, organization responsibilities, state by state estimates versus a single national total, and a decision on which years shall be used for the new base period. Further, these problems will be continually complicated by the need to consider relative priority of im-

proving already existing series versus new work.

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With respect to funds, we can only say that the proposed program for agricultural estimates submitted to the Subcommittee on Agricultural appropriations carried no budget commitments. Rather, it states the goal toward which we believe the work should move as opportunity offers. It is true, however, that the first two of the breakthroughs which I should like to see will not be costless; they are not matters of a mere shift in method.

There are some problems relating to organizational responsibilities. If current crop and livestock estimating methods are to be supplemented by enumerative surveys of sample areas, shall this be done by the Agricultural Estimates division or by the Bureau of the Census? Or conversely, if we are to have sample censuses, shall they deal with the many general matters which we should like to cover or shall the questions, the timing, and the speed and technique of summarizing the data be specifi-

cally geared to the crop and livestock estimating problems?

In my own case at least, I conclude that the supplying of general information and the supplementing of current crop and livestock estimating methods are two basically different problems. The two solutions can be worked so they supplement each other, but I believe the demand for general interest data on the one hand and the absolute need for specific timing and speed on the other call for two separate approaches. For crop and livestock estimating purposes, it would seem to me (although any final decision would of course rest with the technicians) that a June survey would have first preference-a survey in which the field work would have to be done in the second and third weeks with the summarization completed by July 1.

Further, it seems to me that such surveys should be so designed as to supply state figures, rather than simply support national totals. There are a number of reasons for this. All too often national totals simply create a shell within which substantial and important shifts can and usually do occur. Basically, we are interested in keeping agricultural planning and decision-making processes as decentralized as possible. This calls for state

and local data, not just a national total.

This question of local or area data is one not discussed here in any detail, partly because it is so well-covered by the report of the AFEA's Agricultural Data committee and partly because it is the main subject of tomorrow's round table on "Meeting Current and Area Data Requirements in a Changing Agriculture." The demand for local or area data does, however, emphasize the need for maintaining accurate state estimates and is also the main argument for maintaining the quinquennial censuses of agriculture.

One problem having to do with county or local area data (beyond census data) is that of financing. In general, where data are chiefly collected for within-state use, the state bears the expense. There is, however, usually cooperation through the state statistician's office in planning and supervision. Also, the agricultural estimates report to the Subcommittee on Agricultural Appropriations specifically indicates that where states have need for detailed basic statistics on any commodity that consideration may be given to supplying such data on a continuing basis under the matching fund arrangements (50 per cent state, 50 per cent federal) provided under Title II of the Research and Marketing act of 1946.

As for shifting base periods, the Secretary of Agriculture has recommended that the reference base for the main price indexes be shifted to the 10 years, 1947-1956. Also, we are now at work determining the appropriate weights and making the preliminary calculations necessary to reweighting the prices paid and prices received indexes on the basis of the average bill of goods or commodity mixes purchased and sold by farmers in the mid-1950's although as our laws now stand, we will, if such new calculations are adopted, have to chain them back to the legally defined reference base, 1910-1914. Meanwhile, there has been some congressional discussion of a possible shift forward, and I should expect to see this whole question developed within the next two or three years as it becomes necessary to consider the selection of a new base period for U. S. economic indexes generally to supplant the current commonly used base, 1947-1949.

This discussion has centered chiefly upon statistical activities within the federal and state departments of agriculture. The Censuses of Agriculture are also essential, supplying both the basic benchmark enumerations underlying much of the crop and livestock reporting work, as well as a large quantity of both detailed and general agricultural information which could not otherwise be obtained. I have indicated the recommendation of the Watkins committee for a series of regularly recurring sample censuses—a recommendation with which I am in substantial sympathy. There are, however, several facets to this matter which I am sure can be better discussed by someone other than myself. Also, the problems involved are well presented by M. R. Benedict and G. M. Kuznets in their discussion "Better Basic Data for Agriculture: Some Possible Approaches" (Proceedings issue, Journal of Farm Economics, May, 1958).

In conclusion, a few words about what has not been discussed.

I have not discussed the gradual inflationary creep in farm costs which is surely one of today's main problems. I have not discussed agribusiness integration, contract farming, and specification buying which are surely all a part of today's agriculture. I have not discussed the price support and farm surplus problems which are surely still with us. Rather, what I have tried to do is very simple. I have said that the collection and release

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I se of our basic statistics month after month, year after year, is not a wholly glamorous task. Statistics are something that many of our colleagues simply take for granted, too much so. We do need some very basic improvements indeed in our statistical activities if we are to accurately measure, understand, and so far as possible rationally control what is happening in today's changing world.

#### DISCUSSION: AGRICULTURAL STATISTICS IN A CHANGING WORLD

PEYTON STAPP\*
Bureau of the Budget

It was with some diffidence that I accepted the invitation to comment on Wells' paper. It is true that I have had some contact over the years with agricultural statistics and have at times even expressed opinions about them. However, my colleague, Ole Negaard, reminds me occasionally that it might be well if I knew more about them, and I am conscious of being an outsider. As I study the situation, it seems to me that there must be certain taboos observed by the insiders and perhaps an outsider can serve a purpose by opening up at least one subject.

Wells' paper is too thoughtful and incisive for me to comment on all aspects of it. It seems to me the backbone of his program involves an enumerated survey of a large probability sample of farms. To quote-"The first and major step is in the nature of a capital outlay. . . . This calls for a basic organization which will allow the use of an enumerative sample covering some 60,000 and 75,000 farms, distributed to be representative of the 48 states, to be enumerated each spring or early summer to obtain acreage of crops planted and livestock numbers, and partially enumerated each fall to obtain final acreage harvested, yields, and end of the year livestock inventories." At another place he says, "Substantial quality improvements in agricultural statistics are not likely until some major break-throughs are achieved. . . . Current crop and livestock estimating methods need to be supplemented by a series of regularly recurring, fast-moving, specifically oriented enumerative surveys of a sufficient number of sample areas to yield usable state estimates for main crops and classes of livestock."

I understand this proposal. It is a net addition to the present program. Now let me digress to an excellent paper prepared by Murray Benedict and George Kuznets on *Better Basic Data for Agriculture* in the May,

<sup>\*</sup> This article contains personal views only.

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1958, issue of the *Journal of Farm Economics*. They recommend that every other five-year agricultural census should be dropped and an annual sample survey of farms substituted instead, at approximately the same total cost over the period. At one point they approach recognition of the fact that an annual survey of farm production (as a census of agriculture is in part) by the Census Bureau and an enumerative survey of farm production by the Division of Agricultural Estimates will look like duplication to many people, will produce similar but not identical data and that these inconsistencies will be awkward to handle, and that such a program cannot, in fact, be developed along independent lines. But they veer away from this point and do not develop it.

Wells faces up to it, but in this way—and it is the only point in which I am in disagreement with him—he rejects it by saying that for crop and livestock estimates so much speed is required that the agriculture estimates survey must be independent.

Let me drop this item for a minute and turn to another segment of what I think of as the same over-all problem. Wells says that better data on farm income estimates are needed. Improvements are needed in gross income, farm production expenditures, and in breaking down annual farm income estimates between classes of farms, especially commercial and noncommercial farms. Separately he says, "The coverage of the costs and returns series for specific types of farms now maintained in the Farm Economics Research Division, Agricultural Research Service, should be substantially increased." I am aware that the sampling problem for studies of costs and returns of types of farms is considered a separate and unique problem from other farm surveys. I am also aware that the intensive work on sources of farm income, detailed items of expense, net returns from farming, etc. which is carried out in the Farm Economics Research Division cannot be used except in the most marginal sense in making the national estimates of farm income.

Let me sum up the problem as I see it. Agricultural estimates need a large sample enumerated survey of farm production; the purposes served by the Census of Agriculture need a large sample enumerated survey of farm production and major expenditure items (along with many other incidental data collected by the Census); farm production economics needs expanded samples of farm output, income, and expenses; work in farm income needs expanded and better data on income and expenses in order to get net income, and if this work is done for type and class of farm the data must come from enumerated surveys.

In the past, these four branches of work have developed independently, drawing on each other but only to the extent that the major purposes of each were not affected adversely. I do not believe that major

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dror expansion and improvement in each can develop further independently. Let me be emphatic about it: I do not believe it could so develop if no one were concerned with duplication of efforts and unnecessary expenditures of funds. Enumerated surveys are the expensive tools of statistics. Of course, like Koffsky's one-eyed cyclops, that is another reason why it can't be done independently—many people in key positions will not permit the duplication and unnecessary expenditure of funds.

But even more important, the kind of data economists need and the kind of information administrators need can only be produced if these varied sources of information are integrated and together made to reflect parts of the total agricultural economy so we do not look at the tail of a horse, the leg of a donkey and the head of an ox. The formal analytical methods mentioned also require integrated and consistent data on the different parts.

Because there will be enough disagreement with my real point, I should protect myself against misinterpretation. I do not suggest that agency X should draw a sample to do *one* thing and prevent all other agencies from doing anything else. I am not saying that agricultural estimates should have an enumerative sample survey with the results out in 10 days and, consequently, that we should forget an annual sample census of agriculture, and that production economics should use these sample farms for their costs and returns surveys. Let me preface my final remarks with a flat statement that I do not know exactly how this program should be developed. I am talking about a major reorganization of agricultural statistics and it would be presumptuous of anyone to feel that he knows how it should be done at this time.

I am suggesting that representatives of each of these units should sit down in a room together and work out a coordinated program. This group should include competent sampling people. Coordination is a painful process. There are two heavy costs: the first is a hard and painful mental exercise to see things in a different orientation; the second is a series of compromises with the ideal, if by ideal one means the single objective rather than a balanced set of objectives. I do not believe you will get a higher order of improvement in agricultural statistics until this is done, and I think the improvement that follows from doing it will make it worthwhile.

## THE IMPACT OF ELECTRONIC COMPUTING ON FARM ECONOMIC RESEARCH

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WHEN invited to discuss this subject I was afraid my experience was too narrow, and my point of view too provincial. I have not escaped these fears, yet I feel that there are some things which I can say about the effect which electronic computing and related activities have had and can be expected to have on agricultural economists.

The effects of two broader topics tend to obscure and to be themselves

obscured by the effects of electronic computing.

One topic might be called the mathematization of economics. A casual survey of our intellectual ancestors is enough to show that this cannot be purely due to the development of computing equipment. However, it is clear that more of economics is being treated in terms of mathematical models and symbols today than in the past, and it is apparent that this development has been stimulated by the development of computing machinery. I doubt that we shall be able to analyze the increased use of mathematics into components due to trend and due to technological change.

The development of data processing techniques is also not strictly a matter of electronic computing, and again, I shall not attempt the precision required to isolate the changes due to electronic equipment. This distinction might be clearer if each of us were to ask ourselves what the status of data processing would be if we did not have electronic computing. I am sure we would agree that calculators and Hollerith techniques would not have remained static.

Developments in data processing of recent years seem to represent an "innovation." According to one author:

"Every innovation is a substitution of capital or land for labor or of labor for land or capital; or of one kind of labor capital or land for another kind. An innovation means a new combination of factors, a new production function, a new marginal productivity curve. Innovations are introduced to affect supply or demand or both; to shift the cost curve downward and the sales curve upward. Cost is reduced by a better way of doing things; sales are raised by an improvement, real or fancied, in the product, or in the art of persuading the consumer.

"Innovation, almost by definition implies uncertainty. It means a change in the data going into profit calculations of the business man. A new method involves rearrangements, repercussions, and unanticipated difficulties. Many an innovation, far from being narrowly localized within a plant, propagates changes across the board. The use of new materials or of a new technique of production may call for new skills, new tools, processes, containers as well as for a recasting of salesmanship."

<sup>&</sup>lt;sup>1</sup> M. M. Baker, *Intermediate Price and Income Theory*. New York: W. W. Norton and Company, Inc., 1955, p. 412.

A principal element of innovation according to this textbook definition is uncertainty. We have passed one phase of uncertainty in data processing. We now know that electronic computing is "a better way of doing things." There remain, however, many rearrangements, repercussions, and unanticipated (and other) difficulties. Some of us have been using this equipment long enough so that many problems can be handled routinely; others are acquiring or have recently acquired computing equipment, and still face problems of deciding when to use the available equipment, and of learning how to use it.

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When the Illiac came into use at the University of Illinois many of us were impressed by stories of the ability of this machine to solve in one-half hour problems that would require many years for solution by the (then) orthodox methods. Consequently, we planned to use the equipment for any very extensive or very complex problems which might arise. Nearly a year elapsed before we discovered the potential of this wonderful machine for "ordinary" or even "small" computing problems. We now use it for very small problems; for example, to compute the correlation and regression constants for two variables with 15 or 20 observations.

The effect of the changes taking place in our "way of doing things" numerically has been and will be quite varied. These effects will vary from the ability to do a given job in less time (i.e., the fitting of a large "limited information" model in one day) to the development of a generation of "specialists and students who like to tinker with machines." <sup>2</sup>

Other effects I should like to classify as "intermediate." Perhaps they are intermediate on some scale of "roundaboutedness." These include, among others, (1) the ability to undertake research which would have been considered impossible or unfeasible with lesser facilities; (2) the development of greater precision in theory, both through empirical testing and through induction and deduction from hypothetical models; (3) the improvement of basic collecting, and better specification of data required through better observation of the effects of defects in this area; (4) interdisciplinary cooperation, stimulated by the same needs.

I should probably say more about the "development of a generation of specialists and students who like to tinker with machines." There is a certain awesome air of esotericism about being a user or a programmer of these electronic marvels. However, the writing of programs, that is the sequence of "orders" which cause the machine to accept data and to generate answers requires special training. There are two kinds of dangers inherent here. The first is that our research and that of our students will tend to become rigid—to be planned or prosecuted in a way that reflects the capabilities of programs which are available, or even more restrictively with which we happen to be familiar. I shall have more to say about programs.

<sup>&</sup>lt;sup>1</sup> Harlow Halvorson, University of Wisconsin, in a private communication.

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The second danger here lies in the number of students attending special programming or data processing courses. There is always a question: For what aspects of training does this activity substitute? I suspect that it frequently substitutes for reading and study in the area of real, institutional restrictions upon the validity of the models of economics.

A specific example related to both of these points is the tendency to emphasize the specifications of the entire model at the expense of detailed, subjective evaluation of results. The examination of residuals in regression problems has often been neglected, primarily, I suspect, because provision for their automatic generation from computing processes has not been provided. This has happened despite numerous examples of the profitable use of such examinations in decisions concerning functional form and the appropriate transformation of the variables.

Our research is thus partly determined by available computing programs and by the system of distributing these programs. We have, therefore, a critical interest in the decision process by which the contents of the computer library are determined.

There is an apparent conflict between the need to have convenient specialized codes for particular problems, and the need to have a library of well-tested general codes. There is constant need to guard against rigidity in research developing through restrictive non-availability of codes or through unfamiliarity with codes. On the other hand, code writing is expensive and the writing of codes already available in another department or at another institution should be avoided.

Let me immediately say that I have no familiarity whatever with manufacturers' procedures for avoiding these dangers. That the procedures have not been universally adequate is apparent from observations of worksheets originating from different computers.

The writing and dissemination of codes is not the only area where certain weaknesses in our usual way of doing things may have an effect on our utilization of computing equipment. Costs of doing research at many institutions are not budgeted in such a way as to make minimum cost methods attractive. There is a tendency to classify expenditures for personnel and other expenditures as separate inputs each with a separate use-restriction. "Other expenditures" may frequently be the limiting input and thus dominate the choice of a production program. Many of us have found this an effective restriction in sample design, and I believe that this same consideration has led many research programs to neglect potential savings inherent in fuller utilization of available computing facilities.

### Survey of Computing Facilities at Land-Grant Colleges

I recently undertook to learn more about the availability of computing facilities in one important sector of farm economics research. A question-

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ing onnaire was mailed to all heads of departments of agricultural economics in land-grant colleges in the United States and in leading universities in Canada.

I should like to express my gratitude to these gentlemen, and to the members of their departments. The questionnaires were filled out and returned, often with accompanying letters describing the status of computing in their respective institutions in more detail than was possible by just answering the questions. I am indeed grateful.

The questionnaire was also sent to the U.S. Department of Agriculture, and was filled out with respect to the work of the Agricultural Marketing Service. I am indebted to Fred Waugh and Earl Houseman for this information.

Most universities now have some electrical or electronic computing equipment. Of the 43 universities in the United States who returned the questionnaires, three indicated that no such equipment was available. The 40 who reported available computing equipment made comments which I have interpreted as follows:

The equipment	
is used regularly	18
is used occasionally	6
is not used	8
was recently installed	5
is being installed	3

These replies refer to a wide variety of calculating and computing equipment, and were not always as unequivocal as in this tabulation. These categories are obviously not completely mutually exclusive.

Another classification is according to the facilities available. We have classified the total responses as follows:

Extensive facilities available on campus	15
Extensive facilities available, but not on campus	11
Limited facilities	8
Being installed	4
Recently installed	6
None available	3

The basis for classification as extensive facilities was intended, in some loose sense to be "IBM650 or better, or equivalent equipment." However, we have hesitated to use this terminology.

Comparing on-campus and off-campus facilities is not entirely legitimate because of the associated relations of work to be done and personnel available. It seems clear, however, that in the "off-campus" group and the "recently installed" group there is a significantly different view toward the areas of usefulness of electronic equipment.

Some quotations may be helpful in illustrating this:

 "We have not been seriously hampered by the non-use of available facilities." ods that

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- "Most current research was planned prior to the availability of computer facilities."
- 3. "Lack of training and experience of research staff with regard to planning research for analysis with computers."
- 4. "Hand techniques still require less time and cost."
- "The problems have usually been of a nature that could be handled on the sorter and tabulator. Thus, the principal effect has been on the volume of data."
- 6. "Many of the jobs performed are not comparable. This and other factors make it difficult to appraise costs relative to a precomputer situation."

The questionnaire included the question, "What have been the principal effects of having this equipment available on:

Number of persons doing extensive computations?

New problems studied?

Completeness of statistical analysis?"

This question should have been pretested. It was frequently not interpreted as I had intended. The answers are summarized in the following table.

TABLE 1. EFFECT OF THE AVAILABILITY OF COMPUTING MACHINES ON CERTAIN ASPECTS OF COMPUTING

	Total No.	Per cent reporting stated effect on										
		Number of persons			New problems			Completeness				
		+	-	0	Na	+	0	Na	+	++	0	Na
Limited Extensive Not on campus	8 15 11	25 73.3 45.5	50 0 0	12.5 13.3 27.3	12.5 13.3 27.3	12.5 86.7 9.1	62.5 13.3 63.6	25 0 27.3	12.5 93.3 0	25 0 36.4	0 6.7 18.2	62.5 0 45.5

The symbols in the caption have the following meanings: +, increase; ++, great increase; -, decrease; 0, no change: Na. no answer.

There is, I believe, a striking similarity between the first and last lines of this table, and they are different from the central line.

Unless these results are attributed to faulty questionnaire design, we must conclude that "available" must usually mean geographically nearby in order for the staff to become sufficiently familiar with the attributes of the machine to properly use it.

The principal reasons given for nonuse of available equipment are: (1) staff not trained in computer use and research not planned for analysis on computer; (2) cost; (3) inconvenience of contracting arrangement.

Roughly one-third of the questionnaires returned were from institutions having extensive facilities on campus. Of these over 70 per cent indicated more people undertook extensive computations as a result of these facilities. It seems clear that extension in the use of empirical methods is a major effect of improved computing facilities, and equally clear that this effect is just beginning to be felt. In the United States 55 per cent of the questionnaires indicated that the equipment was not used regularly. In addition, the regular use of computers in most institutions is still developing, so that the principal impacts are, perhaps, yet to be felt.

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Nevertheless, the development and exploitation of regression, programming, input-output and variance analysis problems have long been limited by the data processing equipment available. With the relaxing of the computing cost restrictions, each of these areas has progressed rapidly as have Monte Carlo methods for evaluating sampling distributions, "fictitious play" for game theory problems, and the evaluation of numerical solutions to certain problems in dynamic economic theory.

We have before us, then, an era in which electronic computing and data processing will have an increasing effect upon our choice of product, the quality of that product, and the cost of that product.

In order to use these new facilities to best advantage we must strive for conditions under which the utilization of computing facilities will be as economical and as easy as possible.

1. Programs available must be widely known, both within and among institutions.

2. Not everyone should have to learn the mechanical details of preparaing data for processing. Specialization is good here as in other work. On the other hand, care must be taken not to let programming specialists prescribe the analysis.

3. The costs of using computing facilities may well be charged to department or station overhead expense rather than specific projects. This would remove an efficient means of allocating computer time, but would place these costs in a category with respect to choice of methods, that is quite comparable to the way personnel costs are charged.

4. Adequate training of the staff, and competent consulting on noncomputing problems related to research programs are other desiderata of a program to efficiently use our new facilities.

# DISCUSSION: IMPACT OF ELECTRONIC COMPUTING ON FARM ECONOMIC RESEARCH

GEORGE G. JUDGE Oklahoma State University

The paper by West provides an excellent discussion of the general aspects of the gains from using electronic computing equipment and the changes this tool has fostered in our outlook on research problems. Economists stand to gain as much as any other scientists in the freedom from

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arduous arithmetic that this tool provides. Anyone who has ever inverted, say a  $10 \times 10$  matrix, or solved a regression or linear programming problem on a desk calculator and then sees these operations performed on an electronic computer, is instantly made aware of the research potentialities of this tool. Since I am in substantial agreement with the remarks by West, I will direct my comments to some general considerations regarding the normative impact of electronic computers on carrying out the steps of the research procedure—normative, that is, relative to my value system which is, of course, structured by biases and prejudices.

In general, as noted by West, the availability of electronic computers has acted to (1) speed up work which otherwise would be done on desk machines and (2) extend the range of problems which it has been found possible to treat. However, before proceeding to extol the virtues of electronic data processing machines, it should be noted that the model, the data and the estimation method are the three interdependent links that give meaning to the results of any quantitative research venture. In principle, tools such as an electronic computer have a servant's status in the research process. However, history has shown that in the development of science, tools also have a life of their own and may even dominate a period or school of thought. Such may be the case in the field of economics at the present time. In any event, changes in tools and changes in emphasis on various problems go together and interact.

In regard to economic models, the availability of electronic computers and the attendant reduction in the computational burden should increase the amount of time that investigators can spend on the heart of the research problem, namely that of constructing economic models that will accurately reflect the phenomena observed in the real world. By not having to worry about the necessary computational resources, more complex models, which in some cases yield more "useful" predictions, can be employed. In many cases an increasing degree of disaggregation in empirical work is necessary for progress in the study of movements of the economy as a whole. The amount of detail that can be recognized and utilized in our models is conditioned by the capacity of available computing and data processing equipment. In any event, the availability of electronic computers should permit the investigator to develop his models independent of the method of estimation and the computational burden. If this is true, I consider it a significant advancement. Also, since there appears to be no unique model for describing economic behavior (usually several admissable models exist), electronic computers make it possible to

<sup>&</sup>lt;sup>1</sup> T. C. Koopmans, The State of Economic Science, New York: McGraw-Hill, 1958, p. 170.

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perform the necessary numerous calculations to show the results in a wider range of situations, thereby providing a more thorough analysis.

In regard to estimation methods, electronic computers make it possible for the individual research worker to utilize the most recent advances in econometric techniques and reduces the need for using what are in some cases more simple and inadequate techniques. One example of this is iterative procedures which are often troublesome when only desk calculators are available and become powerful tools of numerical analysis when programmed on an electronic computer. The open input-output model of Leontief provides another example of a situation where high speed computing was essential for utilizing the data in a manner consistent with the models. In addition, high speed computing machines have put into the hand of the individual researcher a tool which will permit him to take advantage of most of the more sophisticated methods of analysis. This, I believe, is especially important since the probing of ideas, questioning of concepts and the spotting of new problems have come, in large part, from the lone wolf of economic research.

Electronic computers have done much to point up the interdependence and complementarity of numerical and fundamental mathematical analysis. An example of this is that it is not always possible to obtain theoretical criteria for judging the efficiencies of different methods and it is useful to have artificial samples, drawn from populations whose parameters are known, as a basis of empirical assessment. A case in point is the following:<sup>2</sup>

New methods have been developed for estimating the parameters of the equations of a simultaneous system. It can be shown that statistical estimators based upon these procedures have desirable properties when applied to large samples. However, almost nothing is known about the properties of estimates computed from small samples. There are two lines of research which could increase our knowledge of the properties of these estimators. One is mathematical analysis and the other is numerical and experimental. By using a high speed electronic computer, the problem can be attacked numerically by performing a series of sampling experiments (a variation of the so-called Monte Carlo technique). From an investigation of this type, information should be forthcoming on (1) bias and efficiency of the various estimates and (2) the sensitivity to failure of some assumed specifications of the statistical model.

It is interesting to note that in a recent book, The Lognormal Distribution by Aitchison and Brown, a chapter is included on computational

<sup>&</sup>lt;sup>2</sup>Report of Research Activities—Cowles Foundation for Research in Economics, New Haven: Yale University Press, 1957, pp. 24-25.

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problems and several programs are given.<sup>3</sup> This type of action should help to reduce the lag between the introduction and use of methods and one can only hope that this procedure will be followed in other publica-

tions where the main emphasis is on a particular method.

Although we all realize that electronic computers have been a massive technological breakthrough as far as analysis is concerned, it should be recognized that much of the most useful quantitative analysis of today is still done with a hand computer or even on scratch paper. Also, even though we have in our hands a new powerful tool, I feel the major impediment to the development of economics as a science lies in the fact that much of our effort consists less of thinking than of measuring, and in this time of massive cooperative projects, the motivation for togetherness and the rushing back and forth to scientific conferences and meetings, we have a plethora of \$50,000 research grants for \$100 ideas.

In closing I would like to mention in a half-serious way that if one of the larger computing machines (such as the IBM 709) is operating at peak efficiency, it is possible for one to make up to 42,000 errors per

second-an operating efficiency I am not sure we can tolerate.

<sup>&</sup>lt;sup>3</sup> J. Aitchison and J. A. C. Brown, *The Lognormal Distribution*, London: The Cambridge University Press, 1957.

#### IISE OF EXPERIMENTAL DESIGN IN MARKETING RESEARCH

MAX E. BRUNK Cornell University

M UCH marketing research is concerned with the making of reasonably accurate predictions from some systematic study of the marketing structure. Both the crudeness of the device used for the determination and measurement of causal forces and the unknown conditions under which marketing investigations are commonly made restrict the researcher's ability to place a quantitative evaluation on the accuracy of his predictions. The degree of reliance placed on a marketing research result is therefore, more often than not, subjectively determined. In the absence of statistical criteria, public acceptance is based on the reputation of the researcher, argument or repetitiveness of presentation.

Using data from secondary sources or uncontrolled environments, researchers in general have had difficulty with statistical inference. With much marketing research data the computation of fiducial or confidence limits and statistical tests of significance are of questionable value because of the high degree of confounding among causal forces commonly present in such data. The presence of such confounding often casts a cloud of

doubt even over the theoretical assumptions of causality.

Against this background of frustration with statistical inference economists have looked longingly at the highly and recently developed experimental theory touched off by R. A. Fisher in the biological sciences. But the gross dynamic nature of much economic analysis in the past has prohibited or made difficult the adaptation of such theory in marketing research. Marketing researchers have been looking for all inclusive solutions—solutions which are applicable under a wide variety of market operating conditions. Even though they recognize that their aims often lead them in search of phantoms, they have not been particularly content to measure variable effects under some singularly defined conditions. For this reason sample surveys have had greater appeal than experimentation which requires restrictions.

The rapid expansion of marketing research in recent years has led to focusing attention on more and more detailed problems requiring specific solutions for application in comparatively well-known microeconomic environments. These are largely problems of individual management decision rather than general problems dealing with over-all marketing policy. This trend quickly turned the attention of some marketing researchers to the principles of experimentation. In the absence of both a suitable theory of experimentation and a knowledge of appropriate statistical procedure, early efforts in both experimental design and statistical inference were

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structured on weak and sometimes false premises. But such an approach is not altogether to be regretted for out of it is emerging a stronger theoretical framework than would have been possible if the techniques of experiment had been entirely purloined from the physical scientist. This I feel is true even though the marketing researcher has by this devious route added comparatively little knowledge to the general field of experimentation.

It is my intention in this paper to trace the development of the use of experimental designs in marketing, criticize some uses and then explore adaptation of experimental design to new areas of marketing research.

The use of experimental designs in marketing research has been largely restricted to retail store tests of consumer preference, merchandising practice effectiveness and price-purchase response measurement. The development of self-service stores made it possible to study buying behavior in a specifically defined environment without awareness on the part of the subjects being studied. The advantages of such an approach in avoiding both measurement and behavior biases are obvious. But such an approach in marketing research also has very definite limitations in establishing reasons for behavior. The biologist is compelled to suffer the handicap of dealing with mute animals and plants but not so the social scientist. This in large part may explain the far greater emphasis on experimentation in the biological area.

### Preference Studies

To my knowledge the first use of experimental designs in marketing research was made in Abrahamson's¹ and in Godwin's² studies of consumer preference. The design in these studies involved a simple successive simultaneous matching of alternative lots in retail stores with conclusions regarding preference based on relative volumes sold. Since then many studies of preference have employed this same basic block design which has come to be known in marketing as a "matched-lot" or "paired comparison" design.

The severest criticism of matched-lot preference tests can be directed at researchers' interpretation of results rather than at any shortcoming of the design. The design appears suitable to meet the theoretical requirements for measuring preference but preference discovery has little appeal unless it has sales significance. In spite of the fact that the design does not permit measurement of sales effectiveness, researchers have been in-

<sup>1</sup> Martin A. Abrahamson, Consumer Preferences for Sweet Potatoes, North Carolina Agricultural Experiment Station, Technical Bulletin 82, February 1947.

<sup>&</sup>lt;sup>2</sup> Marshall R. Godwin, Some Economic Aspects of Consumer Packaging as a Method of Retailing Fruits and Vegetables, Ph.D. Thesis, Cornell University, September 1949.

clined to draw such inferences.<sup>3</sup> Such flagrant and repeated misuse of one of the most elementary forms of experimental design is not only difficult to understand but also indicates the dire need for the development of a sound experimental theory in market testing.

It is my belief that experimental design is of limited value to researchers concerned with the problem of consumer preference. It is comparatively simple to design and carry out experiments in retail stores in which consumers are offered free choices and from these draw conclusions concerning preference. It is also logical that preference can best be expressed in a market where there is a free choice of several alternatives. But it must be recognized that preferences determined in such a market apply only to markets where identical choices are maintained. Determination of choice without consideration of application may be an important phase of preference studies, but the real challenge in the study of preference is in the measurement of intensity of preference and the discovery of basic reasons for preference. If the researcher is satisfied that he can successfully rank degrees of preference intensity, then such devices as Scheffe's analysis of variance for paired comparisons offers some advantages in design efficiency. But, in general, it is safe to assume that experimental design has comparatively little to offer in the study of preference.

Occasionally the comment will be heard that usually the same order ranking of treatments will be found when a number of treatments are compared in either matched-lot or rotational types of design. Such an occurrence can be expected when the intensities of preference for the alternatives approach equality but the assumption of equal or near equal intensities of preference may lead to false conclusions and does not justify the use of simple "matched-lot" tests as a substitute for more appropriate designs.

## Merchandising Studies

Experimental designs in marketing research have reached their highest degree of development in so-called merchandising experiments. In these cases researchers were interested in determining the effect of specifically identified practices on volume of sales. Characteristically these studies have employed rotational designs in order to maximize control over time and space variables. Such controls are desirable because of the implicit requirement that tests of alternative practices be made in realistic environments. Latin-square designs, which meet this requirement and are comparatively simple, were first used in experiments of apple merchandis-

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<sup>&</sup>lt;sup>1</sup> Preference may or may not have sales significance. See Max E. Brunk, "Controlled Experiments in Merchandising," *Journal of Farm Economics*, December, 1953.

ing beginning about 1948. Since then many workers have employed the same design in merchandising research with a wide variety of products,

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Basic limitations in the design have led to the development of more elaborate designs, though these have been distressingly few in number considering the many possibilities. Cross-over designs employing k minus 1, k × k Latin-squares were developed for purposes of measuring shortrun carryover effects which are present to some degree in any rotational design. Graeco Latin-square designs have in several instances been employed to permit simultaneous measurement of several sets of treatments and thereby increase experimental efficiency. Youden or incomplete Latinsquare designs are in many instances more practical than the orthogonal designs commonly used. They offer much potential to the marketing researcher but little precedence has been set in their use. Likewise practically no use has been made of factorial designs which if properly employed would serve to explore a much wider range of test variables with given resources. Their absence from the literature can only be explained by the researcher's apparent lack of advance knowledge concerning the behavior of the major variables over which he is attempting to gain a maximum degree of control. Careful examination of the various experimental designs leads me to the conclusion that there is a lamentable tendency among marketing researchers to follow beaten paths. There can be little doubt that more boldness in the design of marketing experiments would contribute to the faster development of a well-rounded experimental theory in marketing.

The appeal of rotational types of experimental design is in the degree of control easily gained over nontest variables. Theoretically, two of the most troublesome variables, time and space, are controlled in the simple Latin-square design. Control of these elements permits a more precise measurement of treatment effects. Assumptions implicit in such a design are independence of rows, columns and treatments. To the degree that there is interaction, true measurement of treatment effects is limited. It is only reasonable to expect that the response to a given treatment will depend on such things as the size of display in relation to store size, competitive products available in different stores and the like. Such interaction is undoubtedly present in the many merchandising studies that

have been made to date.

Some light is cast on this problem by MacGregor<sup>4</sup> who conducted a series of uniformity trial experiments in seven retail stores with 11 different food products. In these tests all products were offered in an identical manner in all stores and time periods thus guaranteeing no true treat-

<sup>&</sup>lt;sup>4</sup> Murray A. MacGregor, Uniformity Trial Experiments in Marketing Research, Ph.D. Thesis, Cornell University, September 1956.

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ment effects. MacGregor found that there is little likelihood of serious interaction between weeks and stores, but he did find evidence of intoraction of time and stores with treatments.

The presence of such interaction suggested to MacGregor the need for further modification in design, analysis or both. The design could be modified so that an individual experiment is conducted within one store. In such a scheme rows and columns would represent days and weeks. While the day × week interaction is comparatively small, it could be further minimized by dividing the weeks into parts (high versus low volume days) and combining them in the analysis.

An alternative, which alters analysis rather than design, is the employment of some suitable transformation that serves to stabilize variances. For example, MacGregor found that by use of square root transformations of the data he could reduce the number of stores required to detect specified treatment differences by about 75 per cent in the case of 10 different products and 18 per cent in the case of one other product. In these instances the square root transformation reduced the coefficient of variation considerably and also reduced the heterogeneity of store residual variances. Further study of such adjustments in analysis is needed before generalization can be made from this limited experience.

The basic data obtained by MacGregor needs further analysis to examine the appropriateness of the use of F distributions for testing levels of significance in designs applied to merchandising tests. With uniform trial data many possible randomizations<sup>5</sup> could be applied to the treatments so that the variabilities present in experimental designs of this nature could be examined without bias. The development of high-speed computers makes it possible to program analysis of variance so that many designs of different randomizations can be rapidly calculated. Such a study would require large resources but would serve to test some of the theoretical assumptions of experimentation.

A major area of concern with experimental designs used in testing merchandising practices has been with the durability or lasting effects of given treatments. If in the design the treatments are rotated frequently, there is the possibility that false inferences might be made regarding long-term effects. This is particularly true of promotional or price treatments which might lead to "stock-up" buying. Judgment, of course, must enter into the decision regarding time rotation of treatments. Where there is suspicion that treatment effects might be short-lived, it is advisable to extend the experiment and build in trend-measuring devices such as

 $<sup>^5</sup>$  In a  $7\times7$  Latin-square there are 16,942,080 standard squares within each of which there are many possible arrangements. In a  $4\times4$  Latin-square there are only four standard squares and 576 arrangements. This is the reason MacGregor used the larger design.

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periodic within treatment response measurement. For example, treatments rotated once a month or every two months could be inventoried weekly and each succeeding week analyzed for treatment effects. In some experiments it is not wise to prejudge time requirements but determine this based on the time it takes the first application of treatments to stabilize. Another more elaborate device is to employ the principle of the double changeover design<sup>6</sup> which serves to measure carry-over effects of treatments on following treatments.

Many merchandising practices may be relatively short-lived in effects but still have considerable value to the trade applying them. Usually the question of duration of effects is one of whether or not they will be lasting enough to justify the costs of change. More difficult to answer is the question of whether or not a given treatment after a period of time has negative effects. Such questions can only be answered by appropriate design of the experiment.

#### Price-Purchase Response Studies

Experimental designs have an appeal to researchers interested in the short-run effects of price on purchase behavior. By randomizing price treatments in some suitable design, researchers believe it is theoretically possible to isolate the effects of price. Godwin $^7$  and others $^8$  have recently made studies of this nature. Godwin employed a  $7 \times 7$  Latin-square with three price premium treatments, at 5-cent intervals over the going market and three treatments at 5-cent interval discounts. Sales per 100 customers at 15-cent premiums were 34.6 pounds of oranges and at 15-cent discounts, 108.4 pounds. From his results he computed a coefficient of elasticity of 1.16 for the price-purchase relationship.

Godwin does not pretend to have measured demand but he does state that this is "the initial step in establishing such a relationship." Essentially what Godwin has measured is the short-run impact of price on volume of purchases under the restricted condition that the price effects apply when offered in a small proportion of stores of a community. This is more likely to be of interest to the management of individual stores

<sup>&</sup>lt;sup>6</sup>The first double changeover design used in merchandising experiments was adapted by P. L. Henderson from W. G. Cochran, K. M. Autrey and C. Y. Cannon, A Double Changeover Design for Dairy Cattle Feeding Experiments. Henderson's work is reported in Methods of Research in Marketing, Paper No. 3, Cornell University Experiment Station, July 1952.

<sup>&</sup>lt;sup>7</sup> M. R. Godwin, Customer Response to Varying Prices for Florida Oranges, Florida Agricultural Experiment Station, Bulletin 508, December 1952.

Agricultural Experiment Station, Bulletin 508, December 1952.

\* Robert N. Hampton and John L. Kupka, Problems in Retail Pricing and Packaging of Flourers, Cornell University, Misseagraph A. F. 1003, October 1055

of Flowers, Cornell University, Mimeograph A. E. 1003, October 1955.

J. R. Franzmann, G. G. Judge and G. W. Newell, An Experimental Approach to the Estimation of Short-Run Price-Consumption Relationships for Eggs, Oklahoma State University, Technical Bulletin T-73, April 1958.

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than of general interest to the producing industry. This latter point is ably recognized by Franzmann, Judge and Newell in their recent study on the short-run price-consumption relationship for eggs.

Other than the possibility of price treatments in a limited number of stores causing shifts in purchases among stores, there are several other problems in using experimental designs to measure response to price. Responses to price treatments may be affected simply by a knowledge that prices in the test stores are out of line with competing stores. The prices may not be sufficiently different to cause an actual shift in purchases but the very knowledge on the part of shoppers of comparative prices may psychologically affect purchases in the test stores even though no shift in purchases among stores takes place. The chance for bias of this type is probably greater for frequently purchased products and for products having a relatively high degree of price stability.

Another concern with rotated price treatments is the risk of shoppers stocking-up when prices are low and holding-off temporarily when prices are high. If the researcher can successfully predict the length of such carry-over effects, he can measure them by incorporating the changeover feature in his experimental design. But in experimentation, measurement of a nontest variable is usually a poor substitute for control.

Lastly there are definite practical operating restrictions in the conduct of pricing experiments. Generally store management has no objection to price reduction treatments but is usually less than enthusiastic about price premiums. This attitude places a definite limit on the extremes of prices which may be tested. Likewise pricing experiments conducted within the stores of a given firm restrict normal advertising which in turn may affect sales.

The very nature of a controlled experiment dictates that the tests be made in realistic environments. Experiments with short-run price-purchase response might more realistically be conducted by applying treatments to entire market areas rather than to individual stores. Withstanding antitrust implications, the cost of conducting such tests is obviously prohibitive unless some new, more efficient, experimental designs can be developed.

### Interpretation of Experiments

The proper use of experimental designs in marketing research, together with appropriate statistical analysis, depends to a very large extent on a knowledge of the nature of variability of all factors involved. The considerations of experimental design and the statistical method of measuring results can in no way be logically divorced. No design is any better than the analysis to which it is subjected and, conversely, analysis can do little to enhance the value of data obtained from a faulty design. Because

of this interrelationship it seems appropriate to consider within the scope of this paper the problem of interpreting the results of experiments.

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The advantage and, indeed, very purpose of an experiment is to gain maximum control over nontest variables so that the true effects of a restricted number of test variables can be measured under carefully defined conditions. The efficiency of experimental design depends largely on the researcher's ability to minimize variations among those variables he must eliminate or control, to minimize his error term and to maximize his treatment effects. The successful experimenter attempts to develop his design to gain a maximum control over nontest variables without creating an artificial condition that will restrict the application of his findings. Any concept of sampling in experimentation falls entirely within the experiment as conducted. The emphasis that published studies place on statistical measures of significance and confidence often carries a thread of implication that these measures provide a basis for generalization to a larger population. Such inference is obviously dangerous. While variance analysis provides unbiased estimates of causality within an experiment, it provides no basis for generalization beyond the confines of the conditions of the experiment.

There seems to exist some degree of confusion in the manner in which generalizations are drawn from experimental designs and sample surveys. For example, the number of stores in an experiment have been sometimes referred to as a sample. I find myself in total disagreement with this concept of tying together an experimental design and a sample survey.

One recent publication, preporting the results of a controlled experiment, has this to say about its "sample" of 11 stores used in a factorial design:

"Because of the importance of the urban areas of the economy in generating demand for agricultural commodities, it is mandatory that such areas be included in the sample. It would be desirable to draw a sample from throughout the entire country, stratifying on regions, states, city size, income, family size, race and many other social and economic factors. Within the limits of available funds, such a sample was not feasible. As a less ambitious but attainable alternative, Tulsa, Oklahoma, was chosen as the sampling area. Such a choice permitted the sample to include a wide range of income classes, families of varying size, and diverse racial and religious factions, as well as many other unspecified factors. In addition to the above advantages, the choice of a city such as Tulsa permitted greater administrative control over the experiment than could be obtained if several smaller cities had been sampled.

"Within the city, 11 large, modern, self-service markets operating under

<sup>&</sup>lt;sup>9</sup> J. R. Franzmann, G. G. Judge and G. W. Newell, op. cit., p. 15-16.

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the management of a single prominent chain of retail outlets were selected. The stores were located in such a manner that the sampling took place throughout the entire city."

The researcher here was indeed fortunate that "limited funds" and "administrative control" made it necessary to confine the study to one city and to one chain within that city because this decision alone helped him gain reasonable control over many nontest variables which he describes in his "ideal sample." On the other hand, the effort exerted in selecting stores scattered throughout the city only served to reduce his chances of obtaining significant treatment differences. Unless it can be assumed that the 11 stores were proportionately distributed among the nontest variables, the very application of an experimental design to such a "sample" of stores would certainly bias the individual effects of the uncontrolled variables the researcher has been so careful to include and would therefore destroy the very purpose of sampling. In spite of my criticism, it is well that the authors included this statement on sampling, for it served to tell us that the experiment was conducted in 11 stores of one chain. That is where we are left. We do not know how representative this chain may be of other chains in Tulsa, or how representative chains in Tulsa are of all stores, or how representative Tulsa is of the United States!

There are many instances where sampling surveys can be effectively and advantageously coordinated with controlled experiments. Such surveys make valuable contributions to the interpretation of experimental results by describing how the conditions of the experiment fit into the general market environment. While companion sample surveys may aid in evaluating the results of experimentation in terms of applied conditions, the degree of generalization from experiments not accompanied with sample surveys must depend on replication in time and space. Substance, of course, is added by the number and consistency of findings of independent investigations. Only by repeated tests conducted under varying conditions of the market do we approach common concepts of sampling.

### Other Uses of Experimental Design

To date the use of experimental designs in marketing have been largely confined to studies of buying behavior in retail stores. In this area the transition of technique from feeding-lot and field-plot tests has been relatively simple. But there are other areas of marketing research where experimentation may offer rewards.

Experimental designs, particularly of the factorial type, may offer an efficient means of measuring the influence of factors associated with the movement of commodities through both retail and wholesale markets. An attempt in this direction was recently made in a northeastern regional

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protect.<sup>10</sup> Such designs would permit more precise measurement of effects and interrelationships of causal forces such as city size, geographic location, time, type of outlet and the like under specific conditions. Such work might well lead to the development of improved informational services regarding the degree of orderly product marketing.

Researchers in physical operational efficiency may also find that experimental designs offer a more efficient means of measuring true cost differences among alternative work patterns, plant layouts and market arrangements. Such designs may offer a means of controlling or eliminating the effects of such troublesome variables as managerial differences, worker skill and capital resources.

In the area of developing improved grades and standards, the use of experimental design may contribute to a better understanding of the intricate relationship of the many quality factors which together constitute grades and standards. This area is closely related to the whole problem of quality control in the individual marketing firm or in the total market structure.

As marketing researchers in general become more acquainted with experimental designs, we will find a broadening of their use into many phases of marketing which cannot today be predicted. Each additional experiment adds to the fund of knowledge in methodology and contributes to the development of a sound experimental theory in marketing research.

#### DISCUSSION: USE OF EXPERIMENTAL DESIGN IN MARKETING RESEARCH

J. R. BOWRING University of New Hampshire

Brunk has divided his discussion of experimental design in marketing research into general areas of consumer preference, merchandising and price response. This separation is somewhat unjustifiable because each area contains part of the other and such overlapping prevents the clearcut division of interests as is implied. Nevertheless the application of statistical tools originally developed for use by the natural sciences presumes that in studying consumers we must break them down, study each part in isolation, then attempt to fit the findings together in some comprehensible whole.

<sup>&</sup>lt;sup>10</sup> Martin A. Blum, Measurement of Rate of Movement of Apples into Consumption Using the Retail Store-Customeer Observation Method, Ph.D. Thesis, Cornell University, June 1957.

Peter L. Henderson, Measurement of the Rate of Movement of Apples into Consumption and Factors Associated with the Movement of Apples in Retail Food Stores, Virginia Agricultural Experiment Station, Technical Bulletin 129, January, 1957.

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Before discussing the type of design to use, one must first establish the hypothesis to be tested. Unfortunately many experiments are conducted without a clear statement of the problem before adopting an experimental design. Statistics is a means of understanding given observations and of testing hypotheses. It does not pretend to provide the original reasoning behind the experiment. Therefore statistical inference will always be a problem whether the data are from secondary sources or controlled environments. After the establishment of hypothesis, an experiment can be designed to reduce the errors of rejection when true and of acceptance when false. Data from such experiments can be used to explain the variance, and the experimental error can be reduced by means of controls.

It is the possibility of controls in the experiment which will govern the best type of design to be used. Temperature, light and moisture controls allow scientists to test hypothesis with statistical significance. The major control which has been available to economists is *ceteris paribus*. Therefore, the possibility of testing hypotheses in economics under the controlled conditions of large retail stores is very appealing and will undoubtedly add to our knowledge of consumer behavior. The value of such observations through time, however, will depend on the extent to which they can be generalized and the extent to which the controls can be adopted by business firms.

Controls in experiments also limit the application of the data. Yet without the controls we cannot successfully use the established experimental designs as they were developed for the natural sciences. Therefore, there is the danger that highly controlled experiments of consumer demand by types and grade of product, by location and by specific time periods may impose such limits that the results are of value only to the stores which are included in the study. This does not imply that they are not of great value to the participants, but it may require limiting studies to methodology for use by individual firms rather than the accumulation of experiences for general use.

Past studies on price elasticity and demand by both the single equation and simultaneous equation approach have used secondary data and time series. The results can be generalized and used as the basis for marketing policy by the government and by individual firms, despite the variation in results.

The reason for consumer merchandising studies, if the cooperation of store managers is any indication, is to increase total revenue from the sale of food. Therefore experiments should be aimed at testing the elasticity of demand for types of foods by packages, size of unit and grade to provide useful guides for pricing and sales techniques. When merchandising studies fail to recognize the interrelationship of price and cunsumer preference and income, their significance is reduced.

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I would like to have seen a clear statement of Brunk's meaning for experimental design because experimental design has been used in the study of motivation of behavior and the potential dimensions of preference for some time. The Theory of Games is providing experimental design in the study of decision-making and there is continuing interest in activity analysis for production and consumption policies. Perhaps it would be fairer to say that economists have not made adequate use of existing experimental designs in their studies of consumer preference.

In experiments with many variables, such as the store experiments, the problem of interaction will exist. This may be resolved by factorial experimentation or by confounding. Store conditions will rarely allow the investigator to conduct separate experiments for each factor so that interactions must be recognized and studied. However, if sufficient information is already available, study of a single factor or a few combinations may be adequate to test the hypothesis and provide useful answers at lower cost.

I am somewhat concerned with Brunks rejection of the term "sample" in his experiments. If by so doing he implies that his observations are not samples of a larger population of stores and of consumers, then he severely limits their value for general use as well and negates the theory of probability upon which our parametric statistics are based and from which his designs are taken. I agree, however, that the variance analysis provides no basis for generalization beyond the confines of the conditions of the experiment. Therefore until more knowledge is accumulated to allow stratification of stores, the random sample might well replace the selected store approach and the results would then be more justifiably generalized. Certainly sampling does not eliminate the use of experimental design and variance analysis.

Controlled observations of stores on how consumers react to different size or color of package may be of value to the store manager being studied. They can be of more extensive value, however, if they would relate selling practices to the store's total sales rather than to isolated products. The pricing policies of managers are based on total store income rather than the income from specific products. The study of stores should therefore include attempts at linear programming with various combinations of sizes, locations, and types of product to arrive at the best possible "mix" of location, type of product package, etc. In addition we are lacking in adequate estimates of elasticity of demand by grade, type and product. More studies are needed in this area for policy decisions and to provide a goal for present consumer studies.

I would like to reiterate for emphasis that a clear statement of objectives is essential before an experiment is designed and that the results are

useful only in testing previously established hypotheses which must stand the test of logic.

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There are no general rules for the formulation of significant problems. Their recognition depends upon extensive knowledge of a given area. Normally they may arise from cases which will not fit an accepted hypothesis or from attempts at synthesizing conflicting explanations of identical behavior. Research design is of value in setting limits for hypothetical statements the researcher may make in either of these cases if he uses specific measurement techniques. It is no substitute in itself for a clear statement of the problem in terms amenable to measurement.

# SCIENTIFIC PROGRESS AND THE AGRICULTURE OF THE PLAINS AND PRAIRIE PROVINCES

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# EFFECT OF SCIENTIFIC PROGRESS ON SIZE AND EFFICIENCY OF FARMS IN THE PLAINS

L. F. MILLER AND W. B. BACK\*

Oklahoma State University

MUCH has been written and said about a technological explosion in American agriculture, and generally, the increase in size and efficiency of farms has been attributed to this technical phenomenon. We, however, take the general position that while changing technology does create adjustment opportunities for farmers, technological change alone may not be a sufficient explanation for the adjustments that have been and are being made in size and efficiency of farms.

We identify scientific progress with technological advance and we take a firm approach without attempting to consider the social costs and benefits of scientific progress in the Plains. We define technological advance as the creation of potential changes in physical input-output relations whereby, with a given price structure, additional opportunities are created for entrepreneurs to produce the same output at a lower cost, or a larger output at no increase in average total unit cost. Thus, new output-cost relations are created by technological advance, and at least some entrepreneurs have opportunities created thereby to increase efficiency, or to increase size and at the same time maintain or increase efficiency. If we admit that most firms operate at a level of efficiency below the level possible with existing technology, then many entrepreneurs who increase efficiency do so through organizational or resource combination changes independent of technological advance.

Have Great Plains farmers adjusted size of farms, and have they increased efficiency in accordance with the potentialities created by scientific progress? Does technological advance explain the actual increases in size and efficiency made by farmers in the Great Plains? If not, what

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<sup>&</sup>lt;sup>1</sup>This definition of technology is consistent with the meaning of the term as generally used in the theory of the firm, that is, it means "a change in a production function which embodies all previously known techniques." Cf. Yale Brozen, "Determinants of the Direction of Technological Change," American Economic Review, May, 1953, p. 288.

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m does}$  explain these changes? What are the "adjustment problems" of individual farmers in the region that relate to scientific progress?

The major hypotheses which we shall defend are:

(1) Great Plains farmers have adopted most of the applicable technological advances, but they lag in making the organizational adjustments, or adjustments in scale necessary for realizing the potential advantages in efficiency from these adoptions.

(2) Actual adjustments made in size of farms in the Plains with the advent of mechanization could have been made through changes in combinations of resources and technology existing prior to mechani-

zation.

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(3) From the standpoint of the criteria of economic efficiency, the major adjustment problems of farmers in the Plains relate to meth-

ods of attaining larger operating units.

In other words, our major thesis is that, although efficiency of farms in the Great Plains has increased concurrently with scientific progress, many of these increases came about from organizational changes relating to size, and such organizational changes were associated with variables unrelated to changes in the state of technology. Hence, the actual impacts of technological advance upon size and efficiency of farms in the Plains have depended upon the state of other conditions associated with size and efficiency.

Conceptions and General Procedure

In this paper, we use the term "optimum" as the position in scale of operations and combinations of resources representing maximum economic effciency. Only technological and price variables are included in the function for determining this optimum. Existing size and efficiency are functions of the state of technology, prices, and additional variables such as motives of the entrepreneur, his knowledge, asset position, risk, and other dynamic considerations. In some economic analyses, advances in technology are used to explain actual changes made by farmers in size and efficiency. We believe adjustments made by farmers are explainable, but such an explanation requires more variables than are usually handled in static economic analysis. Nevertheless, the efficiency criteria of economics provide a useful point of departure for examining the effects of technological change on size and efficiency of farms in the Great Plains.

According to Chamberlin, size and combinations of resources are functionally related.<sup>3</sup> That is, the optimum proportion of resources in a production process depends, in part, upon size, or upon the aggregate of re-

<sup>3</sup> Edward Hastings Chamberlin, Toward a More General Theory of Value, Oxford University Press, 1957, Ch. 9.

<sup>&</sup>lt;sup>3</sup>Earl O. Heady, "Output in Relation to Input for the Agricultural Industry," Journal of Farm Economics, May, 1958.

sources used. Advantages of specialization in factor use and/or in production may accrue with increases in size. Such advantages, according to Chamberlin, are returns to scale. As technology changes, so does optimum size, optimum combinations of resources, and optimum combinations of products for farms. Changes in technology in the Great Plains create increased potential capacity or efficiency of individual farms. That is, with a given price structure, cost schedules could shift to the right (greater output) and/or lower (greater efficiency) with technological advance. Whether lower costs per unit of output accompany adoption of new technology may depend upon whether the proper adjustment in output accompanies this adoption. Farmers may adopt technology that is in fact, cost-increasing because of such factors as: (1) the expected increases in output not materializing, (2) the lack of alternatives to accept. ing whatever technology is available, as in the case of the new machinery market, or (3) the nonmonetary values that are attached to adopting the lastest technology.

The main ideas of the preceding paragraph are depicted graphically in Figure 1. The average total unit cost schedules, AC<sub>1</sub> and AC<sub>2</sub>, represent size and efficiency potentials for a firm before and after a major technological advance, respectively. The price structure for productive services is assumed to be the same for each technological situation. The potential minimum total unit costs are OP prior to the technological change and OR after the change. On AC<sub>2</sub>, the output OQ can be produced at the same unit cost as the output OP on AC<sub>1</sub>. Thus, the unit cost of production does not decrease with adoption of the new technology unless accompanied by an output increase greater than the increment PQ. Also, the full potential of the technological advance to the firm is not realized until

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output is increased by the quantity PR. These two cost-output relations, we believe, approximately depict the potential size and efficiency of "typical" wheat farms in the Plains before and after mechanization. Scientific advances in wheat farming other than mechanization have been adopted by Plains farmers, but the major effect of these adoptions has been to prevent a decline in yields and in the capacity of the region to produce wheat. However, given these "yieldmaintaining" innovations, year-to-year output is primarily a function of weather, while average unit cost per acre, or per bushel is related to mechanization and size of farms. Mechanization has increased the potential capacity of farms in wheat production (from OP to OR, given "average" yields). However, we believe the gap between actual and "optimum" size of typical wheat farms in the Plains has increased with mechanization. That is, farms may have been nearer the optimum in size as represented by the technological possibilities during pre-mechanization than they are today.

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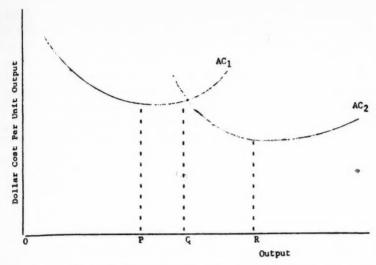


FIGURE 1. HYPOTHESIZED RELATIONSHIP OF FARM SIZE, OUTPUT, AND COSTS

Notably absent from our scheme of thought is an explanation of actual deviations from what is possible, technologically, because of uncertainty, or inability to predict future events. The highly dynamic and unpredictable physical environment in the Plains represents a situation farmers adapt to and accept rather than control. Such an environment may cause farmers to be more conscious of the advantage of size and efficiency than would be the case in a more certain environment. In our viewpoint, uncertainty, per se, is not a variable in size and efficiency in the Great Plains; rather, it is a situation all farmers in the region face. Given the uncertainty in the region as a datum, then such conditions as the asset position of farmers, cost of adjustment, opportunities to adjust, etc., are the variables in observed size and efficiency of farms. We cannot defend the proposition that existing interregional differences in efficiency of agricultural resource use is attributable to interregional differences in weather and/or price uncertainty.

In this paper, we place major emphasis upon crop farms and upon wheat as the leading crop in the region. We do this for several reasons, the more important being: (1) agricultural developments in the region have been led by developments in crop production, principally wheat, and (2) farm technological advance has had more potential consequences for size and efficiency of crop farms than of livestock farms.<sup>4</sup>

<sup>\*</sup>Mechanization in hay production, improvements in transportation facilities, and other technical changes, have had effects on the asset structure and on size and efficiency of cattle and sheep ranches in the Plains. However, cattle and sheep operating units in the Plains states always have been large relative to the crop farms in the

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Our procedure will be to place major emphasis on size of farms as related to technological change and other variables with the belief that: (1) although size and efficiency are not synonymous, they are closely related, and (2) the available facts for the Plains permit better measures of changes in size than changes in efficiency.<sup>5</sup> As indicated earlier, output increases per farm in the Plains, with given weather, are primarily a function of acreages per farm. The task, therefore, reduces mainly to that of explaining changes, or the lack of changes, in acreages per farm which have accompanied technological advances. We wish to emphasize that the readily available facts are limited in usefulness for explanatory purposes. Additional research may produce more acceptable explanations of changes in size and efficiency of farms in the Plains than we have presented in this paper.

#### How Has Size Changed?

The over-all trend in size of crop farms in the Great Plains, however measured, has been upward since 1900, but the short-run trends have varied considerably. We assembled some census data for Kansas and North Dakota to demonstrate the pattern of farm size changes. Selected counties in state economic areas 1, 2a, 3a, and 3b in Kansas and 2a, 2b, 3a, and 3b in North Dakota were used to depict northern and southern Plains, and dry and transition zones of the region. Total acres, acres of wheat harvested, and acres of crops harvested, per farm, for census years during 1900-1954, are sumarized in Tables 1 and 2. We recognize some major limitations in the use of census data, but data are unavailable elsewhere for some of the trends we wish to develop and correlate. However, these limitations are not expected to affect the general conclusions derived from the trends depicted. For example, the trends in size we depict are similar to trends indicated by Goodsel's typical farm studies in the Plains region.<sup>6</sup>

No major change in total acreage per farm occurred from 1900 to 1930 in Kansas and in eastern North Dakota. However, in central and northwestern North Dakota, total acreage per farm increased substantially during this period. This area of North Dakota has a significant number of livestock farms and some of the wheat growing farms tend to be crop-

region, and during the period since 1940 the livestock farms increased but little in size, although this period was the more important since settlement for increases in size of crop farms.

<sup>&</sup>lt;sup>6</sup> Some measures of changes in efficiency as related to technology are available elsewhere. See, for example, Thomas T. Stout and Vernon W. Ruttan, "Regional Patterns of Technological Change in American Agriculture," *Journal of Farm Economics*, May. 1958.

May, 1958.
Goodsel, et al., Farm Costs and Returns, 1956 (with comparisons), Agricultural Information Bulletin 176, Agricultural Research Service, USDA, 1957.

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livestock in type. Total acres per farm decreased slightly in all areas during the 1930's, and increased thereafter.

Perhaps a better measure of size than total acres is acres of crops produced per farm. Acres of crops harvested per farm did increase in the period 1900 to 1930, and expansion of wheat acreage was largely responsible for this increase. Acres planted remained high during the 1930's, but crop failure due to drought drastically reduced the acres of crops harvested per farm. With improvement in weather after 1937, and release of acreage allotments during the war period, the expansion in wheat acres led the development of increased acres of crops harvested per farm. After 1952, nonallotment crops were planted on most of the acres diverted from wheat. An exception to this was the increase in cultivated fallow acreage per farm, primarily in western Kansas, accompanying the acreage allotments on wheat crops since 1952.

A striking feature of the data on crops harvested per farm is the relatively small total increases from the 1920-30 period to 1954 in Kansas and eastern North Dakota. That is, these 1954 farms, with advanced mechanization, harvested only 15 to 20 per cent more acres of crops per farm than did the farms that relied largely on horsepower during the 1920-30 period. Is it possible that the farms in the 1920-30 period could have expanded crop production 15 to 20 per cent (to the 1954 acreage) without further advances in technology and without increases in per unit costs? If we can place some reliance on past farm management studies relating size to net income, the answer to this question is "yes." If we are right in this conclusion, then variables other than farm technological advance are of major importance in explaining farm size changes in the Great Plains since 1930.

# Technological and Economic Development

Mechanization, or the shift from horsepower and related implements to tractor power and related equipment, was the major technological development for crop farming in the Plains since 1900. Other technical advances, such as new varieties of crops, insecticides, and soil management practices, correlate with the developments in mechanization. That is, the adoption of these innovations was highest during the periods of most rapid advance in farm mechanization. Thus, we classify technological developments by stages in farm mechanization. Based partly on the numbers of horses and mules and on the value of machinery per farm, we define these stages as follows: (1) pre-mechanization—prior to 1920, (2) transition to mechanization—1920-37, (3) mechanization—1938-45, and

<sup>&</sup>lt;sup>7</sup>A summary of these technical developments is presented by Nauheim, et al, Wheat Production, AIB179, ARS, USDA, 1958.

Table 1. Trends in Acreages per Farm, West and East Central Kansas, 1900-1954

74					Census Year	s Year				
Trem	1900	1910	1920	1925	1930	1935	1940	1945	1950	1954
Acreages Per Farm				Thirteen	Counties	in Western				
Fotal acres of land	989	513	620	572	584	578		787	718	786
Acres of wheat harvested*	88	150	154	161	221	107		988	287	167
Acres other crops harvested	76	2	84	95	95	37		86	09	148
Total acres harvested*	110	157	638	998	316	144	148	355	297	315
Acreages Per Farm as Per Cent 1954 Acreages										
Fotal acres of land	87	65	79	73	74	7.4	86	100	91	100
Acres of wheat harvested*	63	06	99	96	132	64	59	141	142	100
Acres other crops harvested	49	20	57	64	64	52	88	28	41	100
Total acres harvested*	35	20	26	81	100	46	47	103	94	100
reages Per Farm				Thirteen	Counties in	entral	Kansase			
Total acres of land	223	916	653	230	242	933	248	818	293	328
Acres of wheat harvested.	46	49	83	81	95	77		109	129	103
Acres other crops harvested*	81	86	69	20	99	46		99	46	86
Total acres harvested*	123	181	145	151	151	193	136	175	175	185
Acreages Per Farm as Per Cent 1954 Acreages										
Total acres of land	89	99	70	20	74	7.1	26	85	68	100
Acres of wheat harvested	41	48	81	42	86	75	66	106	125	100
Acres other crops harvested*	66	100	92	85	89	26	41	80	56	100
Total acres harvesteda	99	7.1	78	8	8	99	74	95	95	100

Crop acreages apply to year immediately prior to census year except 1954.
 Thirteen counties as follows: Cheyenne, Finney, Hodgeman, Ness, Rawlins, Sheridan, Thomas, Trego, Ford, Gray, Meade, Seward, and Stevens.
 Thirteen counties as follows: Clay, Cloud, Dickenson, Harper, Harvey, Kingman, McPherson, Marion, Ottawa, Reno, Saline, Summer, and

Table 2. Trends in Acreages per Farm, West and East Central North Dakota, 1900-54

						Census rear				
Acreages Per Farm	1900	1910	1920	1925	1930	1935	1940	1945	1950	1954
and the second s			Eleven Co	ounties in	Central and	1 Northwes	tern North	Dakotab		
	341	344	469	469	528	487	546	625	748	818
rvested	46	7.1	106	120	142	12	88	147	189	143
-da	79	98	137	127	132	20	93	159	149	239
	121	157	243	243 247 274 62 182 299	274	69	186	668	338	386
Acreages Per Farm as Per Cent 1954 Acreages										
P	46	43	22	57	65	09	99	76	91	100
	66	20	7.4	84	100	00	69	103	132	100
	33	36	57	53	55	21	33	64	62	100
	35	41	64	65	79	16	48	78	88	100
Acreages Per Farm				Eleven Cou	Counties in E	Eastern North	th Dakota°			
	181	460	464	444		415	492		560	595
	84	162	141	127	142	25	106	157	167	129
_	92	126	168	174	153	79	128	160	149	215
	09	888	309	301	295	131	934	317	316	344
Acreages Per Farm as Per Cent 1954 Acreages										
	68	77	78	75	43	20	88	94	94	100
eda	65	125	109	86	110	40	86	155	129	100
esteda	35	59	78	81	7.1	37	09	7.4	69	100
Total acres harvested <sup>a</sup>	47	84	90	88	98	38	89	36	36	100

Crop acreages apply to year immediately prior to census year except 1954.
 Eleven counties as follows: Burke, Burleigh, Divide, Emmons, Kidder, Logan, McIntosh, McLean, Mountrail, Sheridan, and Williams.
 Eleven counties as follows: Barnes, Benson, Cavalier, Eddy, Foster, LaMoure, Ramsey, Rolette, Stutsman, Tourer, and Wells.

(4) advancement in mechanization—1946 to present. We subdivided these stages into periods representing differing economic and policy conditions relating to the asset positions of farmers and nonfarm employment opportunities. A simple tabular model depicting the general trend in these variables is shown in Table 3.

Nonfarm job opportunities either increased or remained attractive to rural people seeking urban employment for all the periods except 1930. 1937. The depression, or lack of nonfarm job opportunities, during the 1930's must have contributed to the small reduction in size of farms during that period. Also, farm size increases were greatest after 1940 when

nonfarm employment opportunities were never better.

The asset position of the farmers has had a mixed trend since 1900. After farmers incurred debts and mortgaged property at inflated prices during 1910-1919, foreclosures were very high in the Plains states during the 1920's. Yields of wheat also were lower during the 1920's than during the preceding decade. The asset position of the farmers decreased further with still lower prices and yields during 1930-1937. Foreclosures, however, were lower during the depression years than during the 1920's. Debt relief and more tolerance on the part of creditors during the depression held the foreclosures down to a relatively low rate for this period of distress. Also, for many farms, the salvage value of the assets was far below their value in production under yield and below price conditions usually expected by Plains farmers who were inclined to wait for conditions to improve. After 1937, both yields and prices for wheat increased, and, even though acreage allotments were in effect during 1938-1941, the financial position of farmers in the Plains continued to improve until about 1952.

A series of favorable income years adds to the potential ability of farmers to increase size and efficiency through capital investment. However, the actual making of such investments to increase future income-earning potential may be functionally related to the income-earning incentives of farmers. It is possible that farmers invest only to the level estimated as necessary to create the potential future incomes deemed "satisfactory," and use their remaining capital for current consumption.

An effect of the improvement in financial position can be observed in the decrease in tenancy during 1942-1952. The part-ownership tenure pattern which presently is of major significance in the Great Plains received its greatest impetus during the two world wars. In 1954, more than half of the operators of crop farms in the Plains states were part-owners. In the period 1946-1952, the percentage of operators who were part-owners continued the increase initiated in the preceding war period, and part-ownership as a tenure pattern provided the instrument by which farm sizes increased during the 1942-1952 decade. An increase in the proportion

Table 3. General Classification of Technological and Economic Developments Relating to Farm Size Changes, Great Plains, 1900 to Present\*

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			Change	Changes from Preceding Period	Period	
Stage in Farm Mechanization	Period	Farm Sizeb	Nonfarm Employment Opportunities	Asset Position of Farmers	Proportion of Land Rented	Percentage of Part-Owners
Pre-Mechanization	1900-1909 1910-1919	Increased	Increased	 Increased	 Increased	Increased
Transition to Mechanization	1920-1929 1930-1937	Increased Decreased	Contd. high Decreased	Decreased Decreased	Increased Decreased	No change <sup>d</sup> No change <sup>d</sup>
Mechanization	1938-1941 1942-1945	Increased Increased	Increased Increased	Increased	Increased Decreased	No change <sup>d</sup> Increased
Advancement in Mechanization	1946–1952 1953–	Increased Increased	Contd. high Contd. high	Increased Decreased	Decreased Increased	Increased No change

Changes in farm size and rental situation based upon census data for selected counties in Kansas and North Dakota.

b Relating to total acres of crops harvested.
 Relating to yields, prices, policies and indebtedness of farmers.
 d.i.e., change negligible, less than 1 per cent.

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of land rented, rather than an increase in the percentage of part-owners, accompanied the increase in farm size after 1952.

It appears evident that the power of the general economy to draw rural people out of Plains agriculture and the financial status of farmers were major variables in farm size changes since 1900. Perhaps technical progress, particularly mechanization, was a necessary accompaniment to size increase because of the greatly reduced labor requirement associated However, we decline to assign the role of prime mover to technology in explaining actual changes in size made by farmers. Technology created the potential for increases in size; other variables explained the actual size changes. This conclusion is consistent with a hypothesis that the majority of farmers in the Plains region operate at a level considerably below their potential size and efficiency made possible by mechanization. In 1954. nearly half of the farms in the sample areas of North Dakota and western Kansas were less than 500 acres in size. In east-central Kansas, more than 80 per cent of the farms were less than 500 acres in size, and less than 3 per cent were greater than 1,000 acres. Perhaps the change in acreage of the "average" farm fails to adequately depict the role of technology in farm size changes. The variation in acreages of Great Plains wheat farms has increased with the advent of mechanization, which simply suggests that some farmers have the combination of capital, management, and personal motivation to take advantage of the potential created by technological advances.

# Some Implications for Adjustments

If our analysis of the size and efficiency situation for Great Plains agriculture is correct, then some redirection of research efforts in farm adjustments in the region may be in order. Survival as a goal of families in the Great Plains was postulated by Schickele in 1950.8 Application of this goal would imply that farm size should be inversely related to yield and price differences or changes.

There may be limitations to choosing any one end, including economic efficiency, as the guiding idea for adjustment studies. Survival and efficiency are not inconsistent objectives up to the size necessary to pass the "critical income level." But we do not know how to define the survival limit. What people consider to be a "necessary livable income" changes as their consumption habits and values change. Also, consumption habits or values are functions of levels of income. Since any definition of the survival limit is arbitrary, it may be that efficiency offers a more promising objective of adjustment studies in the Plains region. If considerable

<sup>&</sup>lt;sup>8</sup> Rainer Schickele, "Farmers Adaptations to Income Uncertainty," Journal of Farm Economics, August 1950.

progress can be made in solving the inefficiency problem, the survival problem may disappear. However, we wish to emphasize that we do not refer to efficiency within a fixed acreage per farm.

Some studies of problems of Great Plains farmers have emphasized resource use adjustments within the given farm sizes.9 In the drier portions of the Plains, the climatic and soil conditions severely restrict potential adjustment alternatives within a given acreage. The present advantages of specialization, combined with the restrictive influences of climate and soil, place major limitations on adjustments in land use such as regrassing, fallow, and some soil conservation practices. These limitations are particularly severe for the farmers with the smaller acreages. Scale of operations must be considered when estimating the potential of adding enterprises which require major investments in inputs differing from the kinds of inputs used in present systems of farming. For example, a livestock enterprise requires a set of inputs different from that of crop farming. Thus, it is an enterprise for which scale and efficiency relations exist almost independently of the cash crop enterprises. An enlargement of total resources, or farm size, may permit multiple enterprise farms in the Great Plains where a reasonable degree of efficiency can be obtained for each enterprise. Presently, there are advantages of specialization in factor use and in production. The state of technology in relation to present sizes is a major condition creating these advantages. At the same time, the nature of the land resources and climate limit the range of alternatives for which specialization in production is possible.

More knowledge of the obstacles to increased size of Great Plains farms must be obtained before possible remedies can be proposed. However, with adjustment studies the fashion, we suggest that relatively more effort be put into gaining insight into these problems of increasing size. In this connection, we need to give considerably more attention to the capital and tenure problems which are basic in this problem of increasing the scale of operations.

# Summary and Prospects

Many technological advances characterize trends in crop farming in the Great Plains region. Many more are likely to come forth in the future; presently, Great Plains farmers are lagging in adjustments of size and efficiency with relation to potential adjustments made possible by technology. Such adjustments in size actually made can be explained by developments in the nonfarm economy and by changes in the financial position of the farmers. We can expect continued increase in size and

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<sup>&</sup>lt;sup>9</sup> For example, the studies in many states on the potential uses of land diverted from wheat, possibilities of crop-livestock systems of farming, or the feasibility of changes in production practices.

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efficiency of farms in the Plains region, barring a depression and/or financial distress of the farmers. However, the possibility exists of speeding the adjustment toward the present and prospective technological potential. We believe that "adjustment studies" could contribute more to this problem if they gave greater emphasis to the problems of increasing size and efficiency in adaptable enterprises for farms in the Great Plains. Innovations in financial and legal arrangements to meet the capital problems of larger units deserve serious attention.

# DISCUSSION: EFFECT OF SCIENTIFIC PROGRESS ON SIZE AND EFFICIENCY OF FARMS IN THE PLAINS

# MEYER BROWNSTONE Government of Saskatchewan

Miller and Back are to be admired for their courage in framing rather bold hypotheses and in tackling the subject on a variety of planes. Since I have less time than they, I must select and summarize from their broad canvas and I shall attempt to comment on the main aspects covered, trusting that this does not imply concurrence or rejection in other aspects.

For a quick summary of my appraisal I might begin where I actually ended the analysis of the paper; that is, by my observations on the major hypotheses.

(1) The first hypothesis would be more satisfactory if it were in terms of the diffusion or distribution of technology, since it is not particularly meaningful as an aggregative phenomenon or particularly useful as a basis for policy formulation.

(2) Size adjustments as they have occurred could not be reproduced without modern mechanization.

(3) I would accept the hypothesis that major adjustment problems of farmers in the Plains relate to methods of attaining larger operating units.

I would, in addition, question the significance of the explicit suggestion that organizational changes were associated with variables unrelated to changes in the state of technology. This may only be true if considered narrowly in simultaneous or concurrent terms. I would prefer to state that organizational changes are in most cases technological in themselves and that they are in any case based on some technological event. But the critical issue is the rate of timing of adoption and diffusion of technology throughout agriculture. This, although dependent to some extent on the nature and cost of the technological change itself, is largely a function of some of the factors indicated by the authors.

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In presenting evidence, the authors make certain assumptions about the Great Plains as a type-of-farming region and the relationship between size and efficiency. I have no quarrel with the selection of wheat production as a basis for measuring size increases, but I would question the conclusions drawn on size increases for the area generally and the subregions. The acreage figure used understates size changes and its relationship to technology. It would be interesting to array farms on the basis of technological improvement and then evaluate size changes. In other words, it is quite possible that the size changes noted are all technologically based, but that participation was limited to relatively few farms. Even if I were prepared to accept the statements on size increases and the further statement that these would be possible for each farm without new technology, I would suggest that there are possibilities not considered which lead to different conclusions.

It is possible, for instance, that technology available to certain soil types is not as conducive to large size changes as it is to other types. I think, furthermore, that deeper analysis of subregional differentials would be quite useful. In Saskatchewan, for instance, we find that regional differentials in farm size and size changes are due largely to variable soil productivity, to type of farming and socioeconomic factors relating to time of settlement and type of settler. But this does not obviate an observation that technology accounts for whatever size adjustments did take place.

I want to return for a moment to the evidence on size changes. I would first join with the authors in suggesting other measures of size and, in addition, a separation of size and efficiency. This is necessary because of the varying capital-land or capital-labor ratio between different types-of-farming. Furthermore, within types the relative increase in the machinery and equipment component of "size" implies an understatement of growth if land alone is included.

As to the actual measurement of size changes, I must confess reservations with respect to the "acres harvested" criterion. It is subject to instability which distorts size and productivity conditions. For instance, technology has been largely responsible for expanded summer fallow practices, but this is not reflected in "acres harvested." The authors cite crop failure as a factor affecting "acres harvested" resulting in a distortion of size. Total acreage, I feel, is a better and quite adequate measurement of size in terms of acreage.

Having made these critical comments I would agree with the authors' major conclusions on the basic importance of general economic conditions and of farm financial status in creating conditions wherein technological

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possibilities could be realized. (If I were taking a more generalized view of society and economic development here, I might be tempted to argue that innovation as a technological force should be accorded some consideration as a "prime mover.")

I would underline an observation that general economic conditions have at no time been a sufficient factor in inducing adequate adjustment. Nor have policies directed to improving the asset or resource situation been adequate. Apropos the question of assets, I would suggest that the drive for mechanization and greater size predicated on technology has encouraged a reduction in the asset requirements per farmer. It has done this through a secular rise in the proportion of land rented and in the number of owner-tenant farms. With limited capital available and with major capital risks to avoid, many prairie farmers have chosen to mechanize and to rent, rather than to limit mechanization and to own land. In Saskatchewan, for instance, the owner-tenant combination has risen consistently from 6 per cent of all farms in 1911 to 34 per cent of all farms in 1956. Proportion of land rented, also showing a secular rise, declined somewhat following the 1930's but has stabilized at a high level in recent years.

Owner-tenant farms as a group have more acreage (twice as much as fully owned farms) and have increased more in size than have farms under other forms of tenure. I would thus prefer to interpret tenure changes as an adjustment to technological pressures and the ability to rent as an important aspect of size changes.

The implications for further size and efficiency adjustments are based on an incomplete realization of technological potentials. The authors are correct when they suggest policies in the capital and tenure fields. These are the critical areas and, in general, if we are really concerned with an acceleration of the rate of adjustment either in average terms or in terms of each farm unit, then increased public intervention is necessary. Currently, in Canada, particular attention is being given to national credit policies. These have required profound change for some time now with focus on precisely the problem raised by the authors. If the gains from a mixed tenure system are to be realized more fully, tenure reform is required, ranging from active participation of government in distribution of land to educational programs in landlord-tenant relations. Finally, the whole area of population transfers and rehabilitation requires thorough study and positive policy.

In summary, I am a little more inclined than the authors to attach importance to consideration of scientific progress as an essential element in analysis of size and efficiency changes. At the same time, in terms of public policy, I would be prepared to accept technology as a

datum and concentrate on the factors affecting the rate and extent of

adoption of technology.

I wish, in closing, to congratulate the authors for a paper which has been extremely stimulating and challenging to the reviewer. It is comforting to obtain useful insights from as far away as Oklahoma, and to realize once more that we are, after all, part of a physical, social, and economic region.

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# INSTITUTIONAL ADAPTATIONS TO THE ENVIRONMENT OF THE GREAT PLAINS

STANLEY W. VOELKER
Agricultural Research Service, USDA

TO DESCRIBE all the institutional arrangements that affect land tenure and agricultural finance—or even the more important ones—in an area as large as the Great Plains would be too big an understaking for the time allotted here. To reduce the subject matter to manageable proportions, this paper is limited to three aspects of the overall institutional picture: (1) A statement of general characteristics of institutions adapted to the Great Plains environment; (2) a brief discussion of some of the adaptations being made by agricultural finance institutions; and (3) a description of two relatively new programs—all-risk crop insurance and the Great Plains Conservation program, both of which are still in the formative stage.

### Characteristics of Adapted Institutions

The outstanding characteristic of the Great Plains is the relatively high variability of precipitation and other weather phenomena around means that are only slightly above the minimum required for successful agricultural production. The droughts, torrential rains, destructive hailstorms, crop diseases, insect plagues, and late fall and early spring blizzards combine to make this a high-risk region. Despite significant developments in agricultural technology for the Plains, there is chronic need for new cropping and livestock practices that are better adapted to the soils and weather. Moreover, crop production in the Plains expanded materially during and following both world wars. There is need to adjust production to peacetime market demands. The institutional complex serving agriculture is as much a part of the adjustment picture as are the individual farm and ranch operators.

The most obvious characteristic of an institution adapted to the Great Plains environment—or any other environment, for that matter—is that it serves the people. This is a truism, but one we tend to forget. When an institution fails to achieve and maintain effectiveness in serving people, it may be superseded by another, better adapted institution. When a private or quasi-public institution fails to serve the people effectively, our tradition is to create a new governmental program.

A second characteristic of an adapted institution is that it must operate with reasonable efficiency. Many agriculture-related institutions supply farmers and ranchers with services for which they pay. Institutions whose operations are not a direct cost to agricultural producers represent a cost

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to society as a whole. Frequently, efficiency is related to volume of business. Because of the relatively sparse population of the Plains, service areas must be large if they are to provide a large volume of business. As size of service area is increased, however, problems of communication increase also, while effectiveness of service decreases. The adapted institution thus is one that can solve the chronic problem of size of service area. Usually, this means some compromise between effective service and efficiency.

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se st A third—and probably most important—characteristic of an institution that is adapted to the Plains is its ability to live with wide year-to-year fluctuations in agricultural production and income within its service area. This requires a high degree of flexibility in organization and operation. In the economic sense, most of the agricultural institutions under consideration are "firms." Their continued corporate existence depends on their maintaining financial solvency. In some instances, elaborate safeguards and regulatory controls have been established by government to guarantee their continued solvency. For commercial banks, these controls are more stringent than usual because of the necessity of maintaining standards of liquidity as well as solvency. To offset the effects of wide fluctuations in agricultural income, well-adapted institutions use such devices as financial reserves, diversification of business by serving industries other than agriculture, and ready access to capital or credit from sources outside the Plains.

In short, the characteristics of an institution well adapted to the Plains environment may be summarized as operational flexibility and financial stamina. It must have the ability to "roll with the punches," to change its method of operation as conditions change. Also it must have the staying power to "ride along" with the people it serves during periods of adversity.

# Adaptations in Agricultural Finance

In the field of real estate credit in the Plains, the trend has been away from individuals and commercial banks and towards the federal land banks and insurance companies. These latter types of lenders have expanded their loan programs faster than have other groups. They now hold about 60 per cent of the outstanding farm real-estate debt of the 10 Plains states.¹ Their ready access to capital outside the Plains gives them financial stamina. Their loans are distributed over several types of farming areas, both within and outside the Plains. They are better able to take the "long look" than are individuals and commercial banks.

<sup>&</sup>lt;sup>1</sup>Based on statistical series maintained by the Farm Economics Research Division, Agricultural Research Service, USDA. See *Agricultural Finance Review*, Vol. 13, November, 1950 and Vol. 20, April, 1958; and *Farm Mortgage Debt Rises in 1957*, Agricultural Research Service Bulletin 43-59, September, 1957.

Accompanying this change in the type of lending agency has been a trend away from short-term, single maturity mortgages to long-term amortization contracts.<sup>2</sup> From the borrower's viewpoint, long-term contracts have considerable flexibility. During periods of low farm income, mortgagees generally are more lenient in granting extensions of installments, which constitute only a small part of the total debt; than they are in granting extensions for repayment of total debt under single-maturity mortgages.

Some long-term mortgage plans have built-in repayment flexibility. The federal land banks, for example, encourage borrowers to make additional payments during years of above-average income. These prepayments are put in a special account to the credit of the borrower; they draw interest at the same rate as the mortgage. During years of low income, the borrower can use any funds in his prepayment account to meet annual install-

ments of interest and principal.

Long-term financing must be based on some concept of "normal value," but the application of such concepts in the Great Plains is especially difficult, because farm income varies so greatly from year to year. A federal land bank may say that it will loan up to 60 per cent of "normal agricultural value," but to a prospective land purchaser this may mean only 25 or 30 per cent of current land prices. Some insurance companies are willing to loan more per acre than the land banks are doing.

One effect of the spread between normal value and current land prices is that only a small part (probably less than 20 per cent) of the amount loaned by land banks in recent years was for the purchase of land. Refinancing of indebtedness held by other types of lenders has been the most

important use made of land bank loans.

The shortage of institutional credit for long-term, low-equity financing of farm real estate is one of the reasons for the large amount of real estate credit supplied by land sellers. Some of their credit sales are deed and mortgage transactions, but the trend is toward the use of conditional sales contracts (contracts for deed) for this purpose. Sellers prefer this type of financing because contracts for deed are easier to foreclose in case of default than are mortgages.

If the buyer is able to meet all payments as they come due, the practical effects of contract financing and mortgaging are very similar. The buyer has the use of the land during the repayment period and eventually he gets an unencumbered title to the land. In case of default, however, the purchaser under contract has less security of tenure. In most states, contracts can be foreclosed or canceled in a matter of weeks, but the legal

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<sup>&</sup>lt;sup>2</sup> See for example Betty A. Case, Farm Mortgage Loans Held by Life Insurance Companies, Agricultural Research Service Bulletin 43-58, USDA, October, 1957.

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procedures for mortgage foreclosure, plus the statutory redemption periods, usually mean that three years or more may elapse between date of initial default and the date the borrower finally loses title to the land. Mortgage foreclosure procedures give the mortgagor some chance to salvage at least part of his equity, but whether the buyer under a defaulted contract for deed can salvage any of his investment depends upon the wording of the contract. In many instances, the defaulting buyer loses his total investment.

We have much to learn about contracts for deed and their use. Some of the legal problems are just beginning to emerge. In some areas, contracts have been used for get-rich-quick schemes that bordered on fraud. But this doesn't mean that the conditional sales contract method of financing is necessarily bad. Contracts used by some corporations and individual sellers contain flexible repayment plans, based either on annual crop production or on crop production plus agricultural prices, which give the buyers considerable financial security, thus mitigating the lack of legal security. Research is needed in each state to develop contracts that are adapted to the legal and economic environment of the Plains.

Production Credit Associations (PCA) have several characteristics which should make them well adapted to Plains environment. Nevertheless, PCAs do not provide as large a proportion of the total nonreal-estate credit extended to farmers in the Plains as they do in other parts of the country. For the Plains as a whole, commercial banks supply about four times as much non-real estate credit as do PCAs. The latter seem to have had more difficulty in adapting their programs to the needs of operators in the Plains than in other parts of the country.

Some PCAs in the Plains have not been able to find a satisfactory answer to the service-area problem. Two PCAs, for example, serve the major part of the Plains area of North Dakota. Their service areas are relatively large—roughly 120 miles by 250 miles each. These associations can serve adequately the operators located 60 miles or less from the association offices, but they have few borrowers located farther away. One association has established a suboffice in the western end of its area, but even this adjustment does not enable it to serve adequately all parts of its area. Farm groups have organized local credit unions in several areas to make livestock and machinery loans to farmers, but credit unions are not a satisfactory substitute for PCAs, because their method of finance requires interest charges to borrowers that are 50 to 100 per cent higher than PCA rates.

Another factor is that past policies and programs of some PCA's were not suitable for many farmers who needed some type of intermediate credit to finance the purchase of machinery and livestock. PCA's now are

gradually expanding their intermediate credit operations. For many years their policy in general was to make one-year loans, even though they had authorization to make loans for as long as three years. (More recently, they have been authorized to make loans for as long as five years.) If the loans are large relative to probable annual farm income, as may be the case if the loan proceeds are to be used for purchase of such capital items as machinery and breeding stock, it is fairly common to have a verbal understanding that the loan will be renegotiated at the end of the first year. A Farm Credit Administration survey revealed that 24 to 38 per cent of the loans made in 1953 in the four farm credit districts serving the northern Plains states were renewals<sup>3</sup>

In 1955, PCAs in North Dakota began to finance the purchase of new farm machinery and motor vehicles on one-, two-, and three-year contracts. At present, the interest on these loans is 6 per cent of the unpaid principal, which represents a lower financial cost to the borrower than is the case with the usual conditional sales contract, which is discounted by dealers to commercial banks and credit corporations. Usually, the total carrying charges on these conventional contracts are equivalent to a true interest rate of at least 9 per cent and sometimes as high as 17 per cent. So far, the PCAs have experienced no serious collection problems with this type of financing. One effect of this program has been to bring new new members into the associations.

This spring, North Dakota PCAs made a start in financing the purchase of petroleum products from local consumer cooperatives. Under this program, which had been tried out previously in other areas, the PCA finances the open accounts of the farmers with a consumer cooperative. The latter guarantees payment so that the risk for the PCA is relatively low. The advantage for the PCA is additional business and more members.

In recent years, the Farmers Home Administration (FHA) has been accepted as a permanent financial institution by Congress and by the local financial organizations with which it cooperates. The predecessor agencies, from which the FHA was created in 1946, were established primarily for relief purposes. Because FHA is a government agency and has a trained field staff serving all agricultural communities in the nation, it is a logical instrument through which the federal government can dispense disaster-loan funds whenever the need arises. This last is an incidental function to the basic purpose of FHA, which is to increase capital resources so as to encourage efficient family-type farms. Thus, its main area of concern is

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<sup>&</sup>lt;sup>3</sup> R. C. Engberg, "Needs for Intermediate-Term Credit in the Northern Plains," Proceedings, Conference on Intermediate Credit for Agriculture, July 19-21, 1954, Great Plains Council Publication No. 12.

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ns," 954, the farm operator who appears to have the character and ability to develop into a good manager, but who lacks capital and credit from commercial sources with which to develop an efficient unit. Plains agriculture is in the midst of a technological revolution and the end is not in sight. The capital requirements for efficient farming are still increasing. The problem of the marginal farm will be with us for a long time to come.

#### All-Risk Crop Insurance

In 1948, the Federal Crop Insurance Corporation (FCIC) was reduced in scope and reorganized on an experimental basis with coverage offered for six major crops in some 300 selected counties. Since then the program has been extended to additional counties and crops. Wheat, corn, flax, barley, soybeans, dry beans, and cotton are the chief crops for which insurance is available in at least some Plains counties. In addition, a few other crops are covered under the multiple-crop type of insurance. In 1956, crop insurance was discontinued in 14 high-risk counties of the southern Plains. In these counties, indemnities paid during the preceding eight years had exceeded premiums by nearly \$18,300,000. For the rest of the counties in the program, premiums paid from 1948 through 1957, had exceeded indemnities by 4.6 per cent.<sup>4</sup>

The objective of federal all-risk insurance is to insure the farmer's cash costs of production up to the time of crop loss. This is in marked contrast to the objective of commercial hail insurance, which is to insure the appraised value of the crop at time of loss. The premium-rate structure and the amount of coverage are designed on an actuarial basis so that over a long-time period the premiums will cover the indemnities in each county.

In the case of wheat, for example, the amount of coverage per acre for each county is based on 60 per cent of the county average yield during a 20-year base period. This coverage is assumed to represent the farmers' average investment in the crop. The county average premium rate is based on the average crop loss experienced during the base period. The amount of coverage and the premium rates are converted to dollars by applying a fixed price that approximates the support price. Some counties are divided into two or three subareas on the basis of differences in productivity and risk, with appropriate premium rates and coverages computed for each area. These area rates, however, must average out to the county figure.

In one of the western North Dakota counties, separate premium rates and coverages are being tried out on an experimental basis for wheat after grain, wheat after summer fallow, and wheat after corn or potatoes.

<sup>&#</sup>x27;Reappraisal of the Federal Crop Insurance Program, Federal Crop Insurance Corporation, USDA, February, 1958.

Changes in premium rates in each county are made from time to time. These are based solely on the insurance experience in that county. A policyholder, who has had no loss claims for seven consecutive years, receives a 25 per cent reduction in premiums. Under an alternative provision, applicable to some crops, a policyholder may get a premium reduction of 25 per cent (50 per cent in the case of wheat insurance) when the premiums paid on crops continuously insured exceed indemnities by an amount as large as the full coverage for one year. Only one of these discount plans are available to the individual policyholder, not both.

Generally under multiple-crop insurance, several crops are insured as a single unit. In some counties, policyholders may elect to have each insurable crop handled separately and in a few counties, the policyholder may select the crops he wants to insure. The multiple-crop premiums are calculated on the basis of the number of insurable crops planted and the relative acreage of each in such a way that the greater amount of crop diversification, the lower the premium rate per \$100 of coverage. The reason for this is that the occurrence of any particular hazard may not affect all crops alike; the failure of one crop may be partly offset by a fairly good yield of some other crop. As a result, indemnities over time probably will be smaller and will be paid less often.

North Dakota is the only state in which the crop insurance program operates in every county. Multiple-crop insurance is offered in nine of the 53 counties. The crops covered on the multiple basis are spring wheat, flax, barley, and oats in each of the nine counties. Winter rye is included in two counties, and rye, corn, and soybeans in still another county. Wheat insurance is offered in the 44 counties that do not have multiple-crop insurance. Flax insurance is also available in 17 of the wheat counties, and barley in six of them.

The 1958 premium rates for wheat insurance varied from \$4.10 per \$100 of coverage in the lowest risk area to \$25.25 per \$100 of coverage in the highest risk area. In about half of the county subareas, the rates are from \$10 to \$15.

Whether the federal government continues to expand the all-risk insurance program will depend to some extent upon the acceptance by farmers, as measured by their participation. Not all farmers need insurance. Some can carry their own risks of crop failure through cash reserves and storage of grain. Some may be able to weather periods of adversity by use of credit or by diversification of farm enterprises. Some insurance men feel that a 50 per cent participation is a pretty good mark at which to aim.

In 1957, 27 per cent of the seeded acreage of wheat in North Dakota was insured. In 20 of the 44 counties, less than 20 per cent of the seeded

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acreage was insured. The extreme range was from 8 per cent to 52 per cent. The reasons for these variations are not readily apparent. There is little correlation between relative risk, as measured by premium rates, and the percentage of participation. Adjoining counties with high and low rates of participation are in both high-risk areas and low-risk areas. Some counties have had high or low participation rates year after year. This suggests that differences in salesmanship may be a factor. In some counties, participation increases sharply in the years following serious crop losses and decreases following years of bumper crops. One conjecture is that a substantial number of operators try to outguess the weather.

Participation in the multiple-crop insurance program has been consistently higher than in the wheat-insurance program. In 1957, the percentage of eligible acreage insured averaged 40 per cent, but in one county it amounted to 65 per cent. A 1954 North Dakota study indicated that the lower rates for muliple-crop insurance was at least partly responsible for the differences in participation between the wheat and multiple-crop program.<sup>5</sup>

There are two possibilities for increasing participation in the federal crop-insurance program: (1) more educational work among farmers; and (2) revision of the premium-rate structure to make it attractive to more farmers. In North Dakota, where the percentage of wheat seeded on summer fallow varies widely from county to county, the establishment of separate rates for wheat after grain, wheat after sun ner fallow, and wheat after row crops would appear to be desirable. Another adjustment which might make federal crop insurance attractive to more farmers would be to give each farmer the option of selecting single-crop or multiple-crop eoverage. As indicated previously, the FCIC is experimenting in a very limited way with both of these possibilities.

# Great Plains Conservation Program

The purpose of the Great Plains Conservation program is to stabilize agriculture and to protect the land from wind and water erosion by helping farmers and ranchers to make changes in land use, to initiate better cropping systems and practices, and to establish soil and water conservation measures.<sup>6</sup> A basic part of the program is a detailed plan of land use and conservation practices on the individual farm or ranch. Federal cost-sharing payments are made for certain approved practices and measures that are performed under contract between the individual farm or ranch operator and the Secretary of Agriculture. Administrative responsibilty

<sup>&</sup>lt;sup>5</sup> Phillip J. Thair, Meeting the Impact of Crop-Yield Risks in Great Plains Farming, North Dakota Agricultural Experiment Station, Bulletin 392, June, 1954.

<sup>\*</sup>The Great Plains conservation program was authorized by Public Law 1021 of August 7, 1956.

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for the program rests with the Soil Conservation Service (SCS). The program currently operates only in 288 selected Great Plains counties, but presumably it will be extended to additional counties in the 10 Plains states from time to time. The first contracts were approved during the winter of 1957-58.

The mechanism of the program is about as follows. The operator must develop a long-term plan for his farm or ranch, including a schedule for carrying out land-use adjustments and conservation measures. Generally, the SCS furnishes technical assistance for developing the plan. It becomes the basis of the contract between the farm operator and the government. The contract, which must run for at least three years, but not longer than 10, sets out the plan of operation on each field and each pasture for each year of the contract period, together with the amount of federal cost-sharing payment, if any, to be made for each practice. The amount of the federal payment for the different approved practices varies from 50 to 80 per cent of the estimated costs. The amount is based on a set of estimated unit costs prepared by SCS for each locality. Funds amounting to the federal share of the costs are obligated when the contract is signed, and the operator receives the payment for each practice or measure as soon as he completes it.

The Great Plains Conservation program does not affect acreage allotments or marketing quotas. Participation in this program does not prevent operators from participating also in other federal programs such as the Soil Bank and the Agricultural Conservation Program (ACP), except that federal payments cannot be made from both ACP and Great Plains funds for the same practice on the same land.

A preview of the Great Plains Conservation program is provided by data from the first 31 contracts approved in North Dakota. The contract periods vary from the three year minimum to the 10 year maximum, although most of them are for four or five years. The operating units covered by these contracts range all the way from half sections to five sections in size. The average is about 1,350 acres, which is somewhat larger than the average size of farm in western North Dakota.

Eight of the operating units contain irrigable land within the Heart Butte Reclamation project, which is still under development. On these units, the major land-use adjustment will be the development of irrigated land for production of feed. Land development for irrigation will account for 88 per cent of the federal cost-sharing payments. The other 12 per cent will be used mainly for grass seeding, establishment of contour strip cropping, and other conservation practices on the dryland portions of these units. About 9 per cent of the cropland on these units previously had been converted to grass and an additional 10 per cent will be converted

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under the Great Plains conservation program. The amount of federal payments for these eight contracts will vary from \$1,882 to \$10,362, with an average of \$4,803 per farm.

In May 1958, the SCS established a priority classification system for operating units, designed to encourage use of Great Plains funds for the more serious conservation and land-use adjustment situations. Units consisting mainly of irrigated lands with little or no erosion hazards were placed in the lowest priority class. Moreover, the policy was established to limit cost-sharing payments for irrigation development to one-fourth of the total contract payment, or \$2,500, whichever is larger. Because of this change in policy and the fact that relatively few Plains operators have irrigable land in new reclamation projects, it is expected that irrigation development will be emphasized much less in the future, at least in North Dakota.

The contracts for the 23 operating units outside the Heart Butte project probably are more typical of those expected to come into the Great Plains Conservation program during the next few years. One of these units is converting completely to a grassland-farming system. Adjustment of the others is a matter of developing well-rounded combination crop-and-livestock units within the limitations of the land resources. All cropland that is subject to wind or water erosion either will be converted to permanent hay or pasture or managed under wind strip cropping and contour strip cropping systems. Winter feed supplies of hay and silage on each operating unit have been planned with reference to probable needs, not only for the unit after adjustment, but also for each year of the critical period during which new grass seedings are established. In some instances, present pastures will be supplemented by sudan grass and other annuals on cropland, especially during the adjustment period. New seedings will be protected by fencing, and stock water will be developed where necessary to get better distribution of stock over the range.

Permanent seedings of grasses and legumes and development of stock water are the two most common practices set forth in these 23 contracts; these account for 28 and 23 per cent, respectively, of the federal cost-sharing payments. Twenty of the contracts provide for permanent grass seeding and 19 for some type of stock-water development. Seventeen of the contracts include fencing—usually for protection of new grass seedings and shelterbelts—and federal payments for this purpose will amount to 9 per cent of the total.

Additional wind strip cropping, contour strip cropping, or both, will be established on 15 of the farms. These two practices will account for 22 per cent of the federal payments. Sod waterways will be established on 15 of the farms and federal payments for this practice, which includes

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grading and shaping as well as seedbed preparation and seeding, will account for 11 per cent of the total payments.

Seven per cent of the cropland on these units had been converted to permanent hay and pasture in previous years. Another 20 per cent will be converted under the Great Plains Conservation program, making a total conversion of 27 per cent. In addition, a considerable acreage of grasses and legumes will be seeded on cropland in long-time rotations.

As intensive planning and conservation development program such as this costs money. The SCS is reimbursed from Great Plains funds for most of the direct costs for technical assistance and administration. The amount of the federal cost-sharing payments per contract will vary from \$1,790 to \$5,946, with an average of \$2,760. As indicated previously, these payments are spread over periods ranging from three to 10 crop years. The average payment per year will run all the way from about \$200 in the case of 5 contracts to more than \$1,000 in the case of 6 others. The average for the 23 contracts will be \$644 per year.

The federal government, however, will be "buying" a lot of conservation for its money. For one thing, each field or pasture in a farm is under the contract, even though no federal payment is to be made for practices in that particular field. All 23 contracts provide that all pastures and rangelands shall be grazed "conservatively," which is defined as leaving 50 per cent of the volume of the forage on the ground at the end of the grazing season. Usually, crop rotations and tillage practices are spelled out for each field. All fallow must be of the stubble-mulch type. Great Plains funds will not be used for any of these practices. If we think of the total federal payment as spread over the entire contracted acreage of each unit, the payment per acre will vary from 60 cents to \$5.57, with an average of \$2.06.

Despite the federal cost-sharing payments, the Great Plains Conservation program has not attracted large numbers of farmers and ranchers to date, nor is it expected to do so in the next few years. SCS administrators anticipate that about 250 new contracts per year will be signed in North Dakota. This is a long-time program, which must be preceded by considerable conservation planning and educational work.

The question is sometimes raised as to the permanency of the conservation work accomplished under this type of program. The operators, of course, are under obligation to carry out all specified conservation practices during the period of contract, but their obligations cease when the contracts terminate. The fact that these operators are investing considerable amounts of their own funds in this cost-sharing venture and that they are trying to build up well-rounded livestock or combination crop and livestock units gives considerable hope that the land-use adjustments

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achieved and the conservation practices established may be rather permanent so far as these operators are concerned. It is possible that some of these farms may be purchased by others who will not be interested in continuing the conservation practices. There is thus some danger that the conservation results obtained could be plowed under in another frantic effort to grow wheat.

# DISCUSSION: INSTITUTIONAL ADAPTATIONS TO THE ENVIRONMENT OF THE GREAT PLAINS

H. R. STUCKY
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Stanley Voelker in his opening statement characterized an institution adapted to the Great Plains as one which (a) serves the people, (b) operates with reasonable efficiency and (c) has ability to live with year to year fluctuations in agricultural production and income. He has listed three important characteristics, and I especially like the fact that he gave "serve the people" first place in his list. However, "serve the people" may be taken from the short-term point of view or from a purely local view. In many cases this procedure may not be of most service to the people. Too often, our programs have been operated with limited objectives and without adequate analysis regarding the ultimate welfare of people being served.

Also pointed out in the opening statement is the "need for adjusting production to peace-time market." This is an important problem in the Plains and especially in wheat production. The U.S. wheat crop this year will be among the largest on record in spite of many programs having "stated objectives" to bring about wheat production and marketing adjustments. Voelker well might have centered a section of his paper on this subject rather than just one line in his introduction.

Following his statement on the characteristics of adapted institutions he lists three areas of interest here, adaptation of agricultural finance, a description of the all-risk crop insurance, and the Great Plains Conservation program.

Agricultural Finance

Voelker states that the trend in real estate credit in the Plains has been away from individuals and commercial banks to federal land banks and insurance companies. This same trend is true not only in the Plains but for the entire country. Also, the lumping of the land banks and insurance companies in one category is not quite acceptable for the Plains area because of the wide difference in the attitude these two types of institutions

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toward repayments and extensions during recessions. Since most insurance companies service their loans from offices outside of the region, they have not, in the past, been as close to the current local situations as have been the National Farm Loan associations. This situation was particularly true in the past depression periods. Some changes in policy have been made by insurance companies since that time. Another important difference is that the insurance companies get their large loan volumes by making loans to large size operations, while the land banks tend to make loans to all size groups.

His reference to the lack of intermediate credit in connection with the PCAs is appropriate, but it could be extended to most lenders. The expensive land development and the large machinery purchases require an adequate intermediate credit program with reasonable interest rates. Farmers generally are seeking a source of credit of this type.

The Farmers Home Administration (FHA) loans have been quite effective in the Plains because they are often made with low equities and on farm business where the risk is high. In fact, in certain areas of the Plains, FHA is practically the only source of farm operating and real estate credit. This organization has a wide variety of loans and in fiscal 1959 has more funds available than for any previous fiscal year. The FHA is authorized to make loans for operation, improvement, development and purchase of family-type farms. It also makes water facility, farm housing and emergency loans, and in 1955 a special Great Plains credit program was established under authority of the act of 1953.

# Crop Insurance

Federal crop insurance is described briefly by Voelker. This program has been in operation for 20 years and, as pointed out, is used by farmers by varying amounts, with an extreme range of coverage from 8 per cent of the wheat acreage in one North Dakota county to a high of 52 per cent in the top county in that state. North Dakota has made more use of crop insurance than other states. Of the 422 Great Plains counties, there were 201 in which federal crop insurance was available in 1957.

Voelker does not state how much help the program has been to the families who actually use this insurance. As indicated above, less than half of the counties have this insurance and considerably less than half of the average in the affected counties is insured. This lack of coverage indicates that it is not fully adapted to the Plains area. However, considerable progress seems to have been made, especially in all-crop insurance coverage.

# Great Plains Conservation Program

The Great Plains Conservation program (Public Law 1021) was launched August 21, 1957, and the first contract was signed on December 19, 1957. As

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Voelker has described the operation of this program in detail. I had expected to find some analysis of how well this program is adapted to the Plains and something of the adjustment it may assist in making.

He points out that the acreage allotments and marketing quotas are not affected by this program. This may be one of the conditions farmers would desire in the contract, partly because of their uncertainty about farm programs gained from past experience. It appears to me that the continuance of acreage allotments and marketing quotas on these lands, especially those seeded to permanent cover, will force the farmers to destroy these practices at the end of the contract period. The Great Plains agricultural council and other groups have been recommending for 20 years or more that a large acreage of land in the Plains should be retired to grass permanently. The maintenance of the allotments on this type of land may tend to defeat the purposes of the conservation program and retard the adjustment of the agricultural production in the Plains to the market demands. With the large wheat carryover and the near record 1958 crop, there is no indication that the land now under Public Law 1021 will be needed for wheat production in the near future.

Two areas which would be appropriate to explore in connection with the Great Plains would be (1) adjusting agricultural production to market demands, and (2) adjusting irrigation development (including water law), especially in connection with ground water development to the needs of the people of the Plains.

# PROSPECTS IN FOOD, NUTRITION, AND CONSUMER BEHAVIOR

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Chairman: Marguerite C. Burk, Agricultural Marketing Service, USDA

# DEVELOPMENTS IN HUMAN NUTRITION RESEARCH AND THEIR IMPLICATIONS FOR AGRICULTURE

L. Bradley Pett Department of National Health and Welfare, Ottawa

NUTRITION is concerned with food requirements and methods of meeting these requirements. Scientific nutrition describes these requirements in terms of various substances commonly found in foods, and is concerned with the selection, preparation, preservation and/or other treatment of foods so that the requirements are fully met both in quantity and quality. Since "nutrition" cannot be realized until the necessary substances have actually been eaten, nutrition must recognize the influences of the availability of foods and the cost to produce or buy these foods, the racial or religious habits which influence people's choices, methods of preparation, and many other factors.

Three of the strongest controls determining what people eat are not ordinary parts of nutrition research. Hunger is the most compelling factor in nutrition for most people in the world today. Secondly, prejudices for or against certain foods exert a strong influence on what people eat. Thirdly, advertising of special products seems to grip people's imaginations and money more than scientifically-established knowledge. It is easier to sell blackstrap molasses or a special protein breakfast cereal, neither of which has special value, than to tell people the truth about nutrition.

Therefore it was with some surprise that I received the invitation to prepare a paper on human nutritional research and its effect on agricultural marketing. At first glance it seemed as though nothing in current nutrition was likely to influence agriculture. Surely tradition and soil and climate would maintain the usual supply of foods in any given area, customary patterns of trade, whether local or global, would move the food around, and family taboos and preferences would decide what foods would be bought. However, current human nutrition research may indeed have some significance for agriculture. Answers may be explored to questions like the following:

(1) May the current research on fats in relation to heart disease continue to depress the market for butterfat? (2) May the increasing emphasis on "protective foods" especially for children and older people, both of

which are increasing in our population, decrease the market for sugars and fats? (3) May the ability of chemists to manufacture starch or sugar or fat or other food constituents decrease the demand for production by agriculture? (4) May current research on radiation in relation to foods introduce new foods and new problems? (5) May discoveries be made on diseases like cancer or diabetes or dental caries that will depress the marketing of some foods now commonly used?

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My own answer at the moment could be a definite "yes" to every question here listed—under certain conditions.

## Explaining Some Nutritional Terms

For the purposes of this paper it will be necessary to use certain terms peculiar to nutrition, and some explanation is desirable.

1. Proteins are very complex substances found in nearly all living matter; they are the chief constituents of the soft tissue of the body—aside from water. All growth and repair thus involves proteins. While other units may be present in proteins they are made up of "building blocks" called AMINO ACIDS. Over 20 amino acids may occur in food and in body proteins. Differences in the amounts of each amino acid, as well as in the order of their linkage in the protein molecule make possible an endless variety of different proteins.

Eight of the known amino acids can not be manufactured by the body and must be taken in through food to keep up the supply needed. These are called "essential amino acids." Food proteins that supply the essential amino acids in reasonable amounts for growth are often called complete proteins or proteins of high biological value.

Most proteins from animal sources are complete. Most proteins from cereals and in vegetables are incomplete. But such plant proteins usually contain considerable amounts of three or four or more of the eight essential amino acids. A small amount of research will disclose which amino acids are missing in the incomplete (plant) proteins of a favoured food like bread or beans. It is usually possible to find some other food, even a plant food, that increases the supply of the missing amino acids when mixed with the first food in a ratio suitable for full growth.

2. Vitamins are dietary substances of widely different kinds, but having two things in common: they are essential for life and health, and they are needed only in very small quantities. During the last 40 years many such substances have been described and about 10 are now recognized as important in human nutrition. More of them will probably be discovered but it seems likely that most of the important ones are now known. Vitamins have dominated the nutritional field for 25 years because they started a revolution in medical thought. Vitamins make you sick when you don't eat them, whereas since the days of Pasteur, people were getting

accustomed to the idea of germs making you sick by getting into your body. This idea of "something you didn't eat" has fascinated people.

3. Minerals or Nutrient elements. These contribute to body structures like the calcium in bones, or they enter into special body substances like the iodine in thyroid hormone or the iron in hemoglobin—the red coloring matter of blood. Only a few such minerals have established functions in the body, but much more research remains to be done in this field.

4. Fats. Many different substances in foods and in the body have the properties used to classify fats or lipids, such as insolubility in water, by solubility in certain organic solvents.

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Many lipids contain units called "fatty acids." These fatty acids that contain a special structure known as a "double bond" are called unsaturated; they can become saturated by taking on hydrogen, as is done in the process of making shortening or margarine. Some of the unsaturated fatty acids have to be supplied through food and have been called "essential fatty acids." The oils from some seeds or nuts often contain a lot of these essential fatty acids, whereas many animal fats do not. One of the lipids is called cholesterol. It is manufactured by the body as needed, so its presence in foods is not important. It is deposited in arteries. Cholesterol circulates in the blood and may reach high levels in some people.

Current Emphasis On Certain Aspects of Nutrition

Table 1 summarizes the frequency with which certain subjects were reported in nutritional journals and at conferences during the last year. Proteins or amino acids averaged one paper in four. Vitamins, minerals and fats were close together with 19 per cent, 18 per cent, and 16 per cent, respectively. The remaining 27 per cent was scattered among many topics.

Trends of Human Nutrition Research

## 1. Proteins and Amino Acids

How much protein you need can be discussed separately from the kind or quality of the protein although they are related. Eskimos are said to live on protein foods and certainly this is possible, especially if eaten nearly raw. It is also possible to live very well on small amounts of protein. Recent nutrition research is beginning to define this lower level.

Quality of Protein is a function of the kinds and amounts of amino acids present. Already protein foods are being classified according to amino acids and this trend will continue. We are close to the point of being able to name, especially for staples like wheat, corn or beans, the first amino acid to limit growth, and then the second and third and so on. Wheat protein is known to lack lysine and tryptophane and meth-

Table 1. The Emphasis Being Placed on Certain Aspects of Nutrition in Current Research Related to Humans. Showing the Percentages of Total Papers in Each of Several Journals and at a Recent Conference

	Nutrition Reviews, 1957	J. of Nutrition 1957	Am. J. of Clinical Nutrition 1957	Am. Inst. of Nutrition 1958 Conf.	Average
Proteins or Amino Acids	22%	40%	16%	24%	25%
Vitamins	9	11	29	27	19
Minerals, incl. Calcium, Iron	31	13	14	14	18
Fats	20	11	14	18	16
Energy or Calories	4	6		4	
Carbohydrates	1	1	5	5	3
Dietary Requirements	2	8 3	3 5 2	0 2	4 3 3
Toxicity, contaminants Specific Diseases	4	3	_	2	2
Obesity	2	2	5	4	3
Cancer	_	<u>8</u> -	5 3	=	1
Dental Caries	1	2	1	-	1
Diabetes	1	_	6	-	2
Storage or cooking	4	_	_		1

ionine, to give them their chemical names. Peanut butter protein lacks sulfur-containing amino acids and so on.

#### 2. Vitamins

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Although vitamins are second in frequency of research reports the vitamin era is passing. Current research is not discovering new vitamins. Therefore the glamour of vitamins will slowly decrease. There is no known difference in effect between a vitamin manufactured by a drug company and the vitamin as found in foods, but this does not mean that they can always be freely interchanged.

#### 3. Minerals

Only a few minerals have established functions for humans. One of these is calcium, and current research tends to lower the estimates of calcium requirements. Research is also classifying minerals into 4 categories: (a) essential and sometimes useful as diet supplements like calcium, iodine, iron; (b) essential but widely present in most foods; (c) essential for some species, not proven for humans; (d) no known function in animal nutrition.

While the number of papers is not a true index to the research which is most likely to influence agriculture, yet it is a starting point for an examination of the trends involved.

The uses of nutrient elements in foods will be guided by these results. While this concerns processors more than farmers, it does get involved in arguments about organic fertilizers and deficient soils.

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#### 4. Fats

There is a lot of evidence connecting dietary fat with heart disease, but the final answer is not available. It will probably continue to affect, far into the future, the demand for milk and meat products. The existence of some disagreement among experts does not alter a number of facts that are generally accepted.

(a) Some fat is needed in the diet, probably about half of what is now eaten in Canada and the United States.

(b) As this essential figure (25 per cent of the calories to come from fat) is exceeded, the cholesterol level of the blood tends to rise, and there is more danger of overweight.

(c) It is assumed that this rise in blood level aids the deposition of fat in arteries. Most people having heart attacks have high cholesterol levels in the blood. Measures to reduce the blood levels also lessen the frequency of a second heart attack.

(d) The kind of fat, as well as the quantity, makes a difference to blood levels. Oils like corn oil tend to lower cholesterol levels, but oils like coconut raise it. Animal fats like butterfat raise blood levels, while fats found in some marine animals tend to lower them. The explanation is not clear yet.

(e) Other factors than fat are involved in the development of atherosclerosis and of cardiovascular renal diseases. Among these heredity is important.

# 5. Energy or Calories

Two trends in research likely to affect agriculture are the studies on older people, and on mechanization. Older people need fewer calories, even for the same job, and as the population ages, fewer calories will be needed or people will get fat. Protective foods containing proteins, minerals and vitamins will be emphasized more and more.

Mechanization sometimes means a need for fewer calories, but not always. A man actually needs more calories for riding on a tractor than for plodding behind a plow.

## 6. Carbohydrates

Very little research is being done in this field, but one trend is interesting. It is the approaching possibility of producing sugar or starch more or less synthetically using sunlight, chlorophyll etc. This may help to feed the world's population in the future. It is not necessarily bad for agriculture since it takes about five times more grain to produce foods like meat, than if the cereal were used directly by humans.

# 7. Radiation

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for ods Current publicity on atomic energy includes much of interest to

(a) Research into storage and transport of substances in plants has

been greatly aided by radioactive isotopes.

(b) Preservation of foods by radiation can be done. Such food is safe to eat but the question is often neglected as to whether the food is still as nutritious.

# 8. Specific Diseases

There is no doubt that obesity, cancer, dental caries, diabetes and other diseases are influenced by diet, but not too much is known yet. Any discoveries in these fields would attract public attention and might reflect on agriculture. For example, mental health problems are much discussed, and recent work shows that B vitamins may reduce the mental confusion of older persons. These vitamins go along with protein foods, and facts like these will emphasize the use of such protein foods, with a further decrease in cereals and starch foods.

## Impact on Agriculture

#### 1. Proteins-Amount

People in Canada and the United States tend to use more protein than they actually require, until the older years. There is no reason against this, but we should not expect less developed countries to reach high levels of protein, especially if it has to be purchased. Older people need fewer and fewer calories, but more and more protein, vitamins and minrals. This may decrease demand for carbohydrate such as supplied by wheat or potatoes.

Quality of Proteins. Quality can be improved if people use one food to build up deficiencies in another. A little milk or fish flour or certain

beans improves the protein in wheat or corn or rice.

It is also possible for the chemist to produce amino acids to supplement natural proteins. At present only one is available in commercial amounts; it is called lysine. There is a real danger to humans if only one amino acid is added to staple foods without careful study of all possible imbalances. There is also a real danger to agriculture, if the food technologist takes over all the job of balancing the diet.

#### 2. Vitamins

Even though the vitamin glamour is decreasing, they will continue to fascinate people for some years. It is easily possible to get all the vitamins

you need from ordinary natural foods. It may even be preferable to do so. As a long-term view all nutritionists seem to agree on these facts, but the availability of chemically-prepared vitamins makes it convenient and often useful to add some vitamins to some foods as a short-term expendient.

Only recently there has been evidence of an adverse effect of one of the most respected of such vitamin additions, namely vitamin D in milk Mothers have become lax about giving vitamin D throughout the growing period, or they have had a false sense of security because the evaporated milk of the baby has contained vitamin D. Two problems have been noted. Mothers did not realize the difference between vitamin C and vitamin D, and have neglected giving babies orange juice to the point that scurvy has occurred. This will not be solved by adding vitamin C to evaporated milk, but rather by more nutrition education. The other problem is the danger of getting too much vitamin D. As it became cheaper the amount was increased, and it is even added to breakfast cereals and other foods. But it was shown many years ago by the late Philip Jeans in Iowa that any amount over 400 International Units of vitamin D may stunt the growth of some children. Intakes ten times that level are common at the present time due to this simple, and seemingly logical development in food technology. Furthermore such developments can have an adverse effect on production.

#### 3. Minerals

If calcium requirements are as low as some current research suggests, there will be less demand for dairy products, which are the chief sources of calcium. Then there is the organic fertilizer controversy. If a plant grows on a deficient soil it will likely have a near average composition—you just do not get as big a crop. The fact that fertilizer gives a bigger crop does not mean it is better nutritionally. Just because boron will give a crop on some Florida soils does not mean much to humans, because boron has no known function in human nutrition.

#### 4. Fats

In terms of foods, fats are visible when we get them in butter, shortening, lard, margarine, or trim them off meat. Fats are less visible in fluid milk, baked goods, and when distributed through the meat to give it better quality. There is no reason for drastic reductions in fat intake, but our present level runs 45 to 50 per cent of our calories coming from fat, whereas 25 per cent would supply our needs. If the public cuts down to 25 to 30 per cent, as it may do, it will be necessary for people to use less butter, less cream, lower fat milk, well-trimmed meats (which may still be well-marbled with fat).

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Other developments are possible. There may be an increase in the use of oils, but the basis for this is not yet established. It is also possible that the chemist and food technologist may enter this field, with substances to be added when you eat all the fat you want. In Canada, this would be discouraged, until the connection between cholesterol levels and health or disease is more clearly worked out.

### Summary

1. In order of frequency of publication, human nutrition research is presently concerned with Proteins and amino acids (25 per cent), Vitamins (19 per cent), Minerals (18 per cent), Fats (16 per cent) Calories (4 per cent), Carbohydrates (3 per cent), Requirements (3 per cent), Radiation, Toxic substances, Specific Diseases.

2. The amount of protein required by adult humans is very small if it is of good quality. Quality of the proteins in foods is now being measured by the amounts of amino acids, especially the eight essential amino acids. Some foods that have incomplete proteins contain one group of essential amino acids, while others contain different groupings. It is thus possible for one food to supplement another in human nutrition. It is also possible for the chemist to make up some of these deficiencies, with potential dangers to human nutrition and to agriculture.

3. The vitamin glamour is waning, but will continue for some years. It is possible and probably preferable to obtain vitamins from ordinary natural foods. The expedient of adding chemically-prepared vitamins (which nevertheless have the same properties as those found in foods), has been useful, but has caused some troubles both for human nutrition and for agriculture.

4. Only a few minerals or nutrient elements are known to be essential for man, and to be useful in connection with the diet. Much more work is needed in this field. Current research seems to show much lower calcium requirements than previously stated; this would affect the milk industry.

5. There is wide agreement on several points connecting dietary fats with diseases that are big killers in America today. Some restriction in the use of certain animal fats is likely to continue. Since other factors are certainly involved there is no reason for drastic reduction in the fat content of the diet, but a reduction to half current levels would accord with current knowledge. Chemical and technological developments may alter this trend.

6. Getting enough food calories is still a pressing problem for most of the world's population, but getting too much is a big problem in Canada and the United States. This trend will lessen demands for carbohydrates as in wheat or potatoes and increase demands for protective foods.

7. Radiation may preserve food, but destroy its ability to nourish adeuately.

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8. Specific diseases like cancer and diabetes have some relation to diet, but current research does not indicate what direction it may take. Nutrition also is a factor in mental health, such as in the confusion of older people, and this may bring more emphasis on protein foods.

### DISCUSSION: DEVELOPMENTS IN HUMAN NUTRITION RESEARCH AND THEIR IMPLICATIONS FOR AGRICULTURE

ROSALIND C. LIFQUIST
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Pett has provided us with a clear, concise resumé of basic information concerning our nutritional needs. I shall discuss criteria used for evaluating nutritional adequacy, and speculate on the effect that changes currently indicated by human nutrition research may have on consumption, particularly as such findings relate to the U. S. food supply.

Any evaluation of nutritional adequacy, whether of a nation's food supply or of food used by families or individuals, presupposes some base of reference. In the United States, the most widely used measures of adequacy are the dietary allowances recommended by the Food and Nutrition board of the National Research Council (NRC). These daily goals for various age groups "are designed to maintain good nutrition in healthy persons in the U. S. under current conditions of living and to cover nearly all variations of requirements for nutrients in the population at large. They . . . afford a margin of sufficiency above minimal requirements. . . . "1

Canada and Great Britain have similar yardsticks. However, the Canadian standard more nearly approaches *minimal* requirements; the British standard aims at maintenance of good nutrition in the average person.<sup>2</sup>

The NRCs recommended dietary allowances "represent quantities actually consumed and do not allow for losses due to storage, cooking, or serving." Therefore, the further away from the dinner table we attempt to measure nutritional adequacy, the larger such losses are likely to be. This is one reason why estimates of the nutritive value of the per capita food supply, which measure the supply of food at the retail level, are better for showing trends than for indicating absolute levels.

<sup>&</sup>lt;sup>1</sup> Recommended Dietary Allowances, Food and Nutrition Board, National Research Council, National Academy of Sciences, Publication 589, 1958 Revision, p. 1.

<sup>&</sup>lt;sup>2</sup> *Ibid.*, pp. 1, 2. <sup>3</sup> *Ibid.*, p. 27.

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Taking into account the above interpretation of the dietary allowances, the NRC stated recently that "the American diet is believed to be as nearly adequate as any enjoyed by civilized man." Hence, it may be that future efforts concerned with improving diets will be concentrated more on specific weaknesses that still exist in American diets and on the application of research findings rather than on major shifts in food supplies.

Recent studies of family food practices indicate the need for continuing nutrition education. The 1955 household food consumption survey (U. S.) showed, for example, that the food used at home by 29 per cent of these households failed to provide the quantity of calcium currently recommended as desirable by the NRC.<sup>5</sup> This occurred during a period of surplus dairy products and when most families had good incomes.

Economic and social changes have been important factors in changing food use. This is illustrated by the fact that today only about one-tenth of the family diets in the United States can be said to be "poor" compared with one-third in the 1930's.6 During this same period, there was a major increase in real incomes. However, from a marketing viewpoint, it must be recognized that after families are able to purchase sufficient food to satisfy their hunger, and then satisfy their desire for variety and better quality, there may be little to move them to buy more food even though they may be willing to purchase more services with the food they buy.

Shifts in age groups within our population in the next 20 years may not have as much effect on supplies as often inferred because of the offsetting effect of requirements of different age groups. So, beyond increasing food supplies to provide for an expanding population and to bring to an adequate level the diets of those families and population groups still in need of improvement (like some of our teenagers and older people), we may not see major shifts in demand arising from economic or social changes if incomes remain at a high level. On the other hand, technological developments may play an increasingly important role in the years ahead.

Pett mentioned the present concern about a possible connection between dietary fat and heart disease, but he also stated that, so far, research has not provided conclusive evidence of a cause and effect relationship. The NRC emphasizes in its publication, *Dietary Fat and Human Health*, that present studies "do not give sufficient data to make firm recommendations on dietary changes" and cautions against "accepting bits of experi-

<sup>&#</sup>x27;Dietary Fat and Human Health, Food and Nutrition Board, National Research Council, National Academy of Sciences, Publication 575, June 1958, p. 4.

Council, National Academy of Sciences, Publication 575, June 1958, p. 4. <sup>5</sup>Based on data in *Dietary Levels of Households in the United States*, USDA, 1955 Household Food Survey Report 6, March, 1957, p. 32.

<sup>&</sup>lt;sup>4</sup>R. M. Leverton and F. Clark, "Development in Human Nutrition," presented at the 35th Annual National Agricultural Outlook Conference, November 19, 1957, Washington 25, D.C.

mental data before the entire picture is clear." But let us suppose for the purpose of discussion that further research does provide evidence that some relationship exists, what might we do in addition to publicizing the facts, to reduce the consumption of fat?

Pett and others have suggested that a goal to strive for might be that of supplying 25-30 per cent of our total calories with fats. This is considerably lower than current consumption estimates of about 40 per cent based on per capita food supplies. However, I believe there are basic differences in these percentages. The lower ones, as I understand it, are usually associated with calories from food as eaten. In contrast, percentages based on calculations of the nutritive value of the food supply represent calories from fat in food measured at the retail level and make no allowance for waste in the home. Allowances for such losses could bring these percentages closer together. Even so, too large a share of our calories may still come from fat and further reductions may be advocated.

The consumption of "visible" fats could be reduced some, but as these represent only about a third of the fat in our dietaries the amount might be relatively small. The largest share of fat is from the so-called "invisible" fat which comes along with other foods, as meats, dairy products (excluding butter), and eggs. Foods such as these are important in our diet and some people need to increase rather than decrease the quantity consumed. Hence, our attention may have to be directed more to changing the proportion and kind of fat in certain of these foods rather than toward limiting their use.

Changes such as these may assume increased importance in the years ahead. But whatever the direction, in the future as in the past, human nutrition research should have important implications for agriculture.

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<sup>&</sup>lt;sup>7</sup> Op. cit., p. 8.

### CONTRIBUTIONS OF CURRENT RESEARCH IN FOOD TECHNOLOGY

EMIL M. MRAK
University of California, Davis

In HER letter of invitation, Miss Burk suggested the discussion of "prospective contributions of current research in food technology to food production and marketing." The title has been reduced to "Contributions of Current Research in Food Technology," but it is presumed that the subject to be covered should relate to the effect of food technology research on marketing with some attention to quality control and identification, use of chemical additives, recent and impending developments in food technology, and recent and impending developments in food packaging materials and methods.

For the sake of orientation, it is well to spend a little time on the background of food research. Activity in the field of food research is quite recent and was in the past mostly defensive in nature, resulting to a large extent from problems arising in the industry. Prescott of the Massachusetts Institute of Technology was one of the first food researchers in this country. His first work was concerned with the spoilage of canned meat

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As the industry developed, it was confronted with more and more problems, some of which were related to can corrosion, spoilage, food intoxications, nutritive value, insects, "browning reaction," etc. These may all be classified as "crisis" or "boom and bust" research problems. The occurrence of crises in the food industry has not only resulted in the stimulation of research but, in one case at least, resulted in the establishment of a trade association. The National Canners association was originally founded as a defense against a newly created Food and Drug Administration. Such a defense of course was not needed, and the association soon turned into a constructive organization looking to the future.

This was the situation in industry until shortly after World War II. The situation in the agricultural experiment stations, however, has been somewhat different. Here food research developed to study crops produced in certain areas. If one follows the development of food research in experiment stations he will observe that the earlier work was concerned with commodities such as pickles, cherries, dried fruits, grain, wine, etc. The rather interesting aspect of this was that the individuals concerned were not necessarily chemists, microbiologists, or intensively trained scientists, but possibly horticulturists, extension people or just plain agriculturists. They did some very fine work, skimming the surface, and laid the groundwork for the intensive type of work that is going on today.

In industry, on the other hand, the earlier food scientists were chemists,

biochemists, bacteriologists, physicists, etc. In either case, these workers lacked orientation and a food technology point of view. The outlook was indeed limited and the worker concerned himself with some rather par-

row aspects of research relating to a particular problem.

Since World War II, however, the outlook has changed and today it is necessary for a food scientist to have the full spectrum point of view. While the research worker may be trained in one field of science, it is necessary for him to consider all aspects of food production, processing, distribution, and utilization. He must think of the raw materials and the relation of raw materials production and handling to the quality of the processed product, and acceptance to the consumer. In line with this, he must also consider the effect of various processing practices on these raw materials, the relation of processed product storage to the quality, distribution, and finally acceptance to the consumer. This present day point of view is quite different from that held by the early food scientists. Most certainly the early worker seldom thought of the consumer or consumer acceptance. It is well, at this point, to indicate some of the factors that are important in consumer acceptance. Naturally, cost is an all important factor but it will not be discussed in this paper.

Other factors important to consumer acceptance are color, flavor, texture (rheology), stability, utility, aesthetics, safety and nutitive value.

By stability we refer to the product's ability to retain quality over a period of time and under various conditions.

By utility we actually refer to convenience. There has been a tremendous revolution in the food industry since World War II and it has been caused to a large extent by the introduction of convenience into the processed foods. Another way of looking at it would be to say that the food processor has taken much of the work out of the home and placed it

into the factory.

By aesthetic values of foods we refer to appearance, sanitation, insect or rodent infestation, etc. Food safety too, is important. Nutritive value has been placed last, not because it is least important, but because if the factors mentioned above prevent a consumer from accepting the food, then its nutritive value is never passed on to the consumer. Furthermore the factors mentioned above, without doubt, influence the consumer more than nutritive value. Broker acceptance is also important for it may be entirely different from consumer acceptance, thereby causing a real problem. Broker acceptance is usually based on opinions rather than scientific data and hence is usually unrelated. Unfortunately, in a number of instances this has delayed improvements in foods. As time goes on, as distributors become more aware of methods to measure consumer acceptance and of the unreliability of any individual's judgment in the matter, this factor should become less important.

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The present day food scientist must consider all these factors. What can we expect, therefore, from a full spectrum research program from production to the consumer, wherein the food scientist is always considering the consumer, producer, processor and distributor. Food acceptance, above all, is receiving much attention today. Methods have been worked out whereby taste panel procedures used to detect differences in a product are quite reliable. It should be pointed out, however, that the expert taste panel is merely used as a "tool" to detect differences, just as one would use quantitative chemical analyses or a microscopic examination. It is not an indication of consumer acceptance. Taste panels can, however, give the processor a very useful tool in quality control and in the development of new processes, formulations and products, and their use has become quite widespread over the past 10 years.

In our laboratories we have been studying the relation of color, flavor, sugar and acid in synthetic solutions to taste response. It has been observed that if all constituents except color are maintained at a given level, and if color is gradually increased, even the taste panel experts will indicate more intensive flavor with increased color up to a certain point. It also has been observed that by increasing the sugar content of certain products, the flavor quality is increased. This is the result of a "salting out" effect. In other words, by increasing the sugar content, greater quantity of aroma is released and this becomes obvious to the tester. On the other hand, if too much sugar is added, the sweetness level decreases the desirability of the product. In line with this, if acidity is increased, acceptance of the product by the test panel is apt to increase. Because of such work we have been able to establish the so-called sugaracid ratios for some of our canned fruits. In order to obtain the proper sugar-acid ratios, it has been necessary to harvest fruit at the proper time and in the proper condition and to subsequently handle it properly so that when the fruit is canned, the sugar-acid ratio will have the greatest acceptance.

It has been indicated that color is a very important factor in foods. This is particularly true of certain canned vegetables. Extensive studies are now under way to determine the chemistry of color changes in canned leafy vegetables with the view that eventually procedures may be worked out whereby the retention of the desired color may be possible.

Because of the realization that such factors can influence consumer acceptance, there has been a re-evaluation of procedures used in the canning of certain fruits. For instance consider canned pears. This fruit has been canned for many years and has been considered a gentleman's crop to handle. It is a fine product, is easy to handle and one that has a good market. It has been realized, however, that in California pears there was an inconsistency in quality which made it difficult to break into certain

markets. A study of factors influencing quality indicated the need to harvest the fruit under carefully controlled conditions and in a rather limited range of maturity. Since pears are harvested when they are green and hard, and allowed to ripen in boxes prior to canning, they are active physiologically until canned. Pears, however, do not ripen uniformly when stored in boxes at room temperature. Because of this, it was found that after picking at a uniform maturity they were chilled to 30°F and then ripened at 68°F at a humidity of 80 per cent they would all ripen at the same time and have a very uniform quality. This was done with the result that the quality of canned California pears has improved, broker and consumer acceptance have increased, and the cost of production has decreased. The cost of processing has also decreased because the yield has increased over 20 per cent and has enabled an orderly operation of the canning plant on an eight-hour basis, rather than a "boom or bust" operation.

Similar work was undertaken for freestone peaches. It was observed that if freestone peaches were picked when green-yellow and very hard rather than when ripe, the quality and yield could be greatly improved. Experiments indicate that fruit picked under these conditions and then ripened at 68°F and at a humidity of 70 per cent result in a canned product superior to that packed from fruit harvested when fully ripe!

## Convenience-the Key

Convenience is the factor being considered in practically all foods and from all points of view. You are aware of convenience foods and the fact that the first developments along these lines have been concerned with the minimizing of effort in the home. Consider the prepared cake, biscuit and candy mixes. But there are other aspects to convenience. For example, there is now on the market the so-called moist-pack dried prune. While there are a few people who like prunes that are relatively dry and chewey and like to drink water while they are eating the fruit, it has been our experience that most people are lazy and do not like to work hard while chewing. Furthermore, they do not like to be bothered about seeking a glass of water when chewing on something dry. The moist pack dried prune is more convenient in that the needed water is built into the product and therefore people eat more of them. Recently, a frozen chopped onion has appeared on the market. It, too, is a convenient food because it eliminates the need for storing, peeling, and chopping, but most of all it eliminates "weeping."

Consider next the convenience aspects of fats. To date there has been little said about the inconvenience of fat on the meats we buy today. If the meat is roasted it not only means there is a loss, but there is a mess to clean up. This is inconvenient. If we could develop meats that

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The convenience of packaging is important. Would more catsup be used if it could be placed in a container other than the usual narrowneck bottle which usually becomes unsightly and which is a hindrance to removal of catsup? Presently, some people are reluctant to use catsup in fear of the possibility of barraging a neighbor while attempting to get it out of the bottle.

There are innumerable factors that enter into convenience and the wise food scientist will consider as many of them as possible. Convenience not only comes into the picture from the standpoint of the ultimate consumer, but also the manufacturing consumer. For example, many dried foods are made today for use in the production of other foods. To be specific, garlic and onion powders are produced to a large extent for the use in products such as catsup, dried bell peppers for use in meat loafs, etc. One processor in California has built his business on the elimination of nuisances confronting other food manufacturers. Truly, the convenience angle is one that has many ramifications and is receiving extensive consideration. Extensive studies are presently under way on the stability of foods with the view of extending storage life. We would like to minimize and even eliminate the loss of flavor, deterioration by the socalled "browning reaction," rancidification, microbial spoilage, etc. It may surprise you to know that at present there are very few foods that can be considered stable. It has been said that salt and whole peppercorns are the only real stable foods. Practically all foods change during storage, although the rate may be slow. We can look forward to advances in this area.

Consider again the factor of aesthetics. Most food processors are today using procedures that do a better job of eliminating foreign material such as dirt, insect infestation, rodents, etc. than can ordinarily be done in the home. The development and use of sanitary procedures in our food plants is proceeding at a spectacular rate. More and more food processors and trade associations are employing sanitarians to keep food plants and the industry as a whole under continuous surveillance. This development has gone so far that there is even a concerted effort to eliminate the presence of the common fruit fly which is ever present, whether it be the home, the orchard or even the desert.

There is also another aspect to safety that should be discussed more extensively at this point. Much has been said about chemical or food additives. There has been a great many scare headlines, misinterpretations, misrepresentations, taking material out of context, etc. There have been conferences relating to environmental carcinogenesis and material has been taken out of texts from these conferences and published in

papers and journals in a manner that would frighten people without any justification whatsoever. Food processors, the chemical manufacturers, the Food and Drug Administration, and others are well aware of the public apprehension concerning the use of chemicals in foods. This is good, but it is unfortunate that the consumer has been so misinformed. The possibilities of harm to the individual are perhaps greater from the standpoint of air pollution, occupational health, waste disposal, water

supply, etc. than from chemical additives.

The National Research Council of the National Academy of Science has a committee concerned with chemical additives. It is known as the Food Protection committee and is looked to by the Food and Drug Administration, the World Health Organization, the Food and Agriculture Organization and others for guidance. This committee has set forth its views with respect to testing the safety of chemicals, and has issued other publications relating to specific chemicals and the use of chemicals in foods. These can be obtained by writing to the Executive Secretary of the Food Protection Committee, National Research Council, 2101 Constitution Avenue, Washington, D.C. In my opinion, because of the general developments in this area, our foods are safer than ever, from the standpoint of additives.

Without the use of food additives it would be impossible to give the consumer the advantages he enjoys today. It would be impossible to introduce the convenience factor and maintain the high nutritive values of our foods. Additives are used in foods for preservation, as nutritional supplements, coloring agents, flavoring agents, agents to improve functional properties, processing agents, moisture content control agents, to control salinity and alkalinity, and to control physiological activities such as ripening, These are all important functions and if we did not have procedures for controlling these activities, we would certainly go back into the dark ages of foods as far as the consumer welfare is concerned.

The food scientist is giving serious consideration to the nutritive value of the finished product. He is considering the relationship of raw materials, processing, storage, distribution and handling in the home to the

nutritive value of the produce as consumed.

Now a few words about what the future may hold for us. Through the use of the full spectrum approach we can expect better products for the consumer and without doubt will keep pace with his changing foodhabits. Improvements will be made whereby the cost to the producer and processor will be decreased. This can involve an increased yield per acre, the use of mechanical harvesting, bulk handling, increased yield from raw materials, and improved storage characteristics of the processed product.

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ments and costs will take place all along the line. Some are even talking of automation. Without doubt there will be new methods of preservation. The so-called high-short procedure of sterilization for foods is now a reality insofar as special foods are concerned. If the procedure can be improved further to enable high scale production, this process would without doubt find wider use. It could result in better yields and certainly in improved products. Furthermore, we can expect improvements of foods through the use of safe chemicals. Much has been said about radiation, but we will have to wait another few years to see what will develop.

There will be many new products. One chain store administrator has indicated that his purchasing agent is confronted with approximately 5,000 new products per year. In recent years the big play has been on convenience products. This probably will continue for some time.

Specific new items that have great promise are fruit concentrates produced in one part of the country for use in manufacturing in other areas as well as in the home. Already we are seeing new fruit juice drinks and formulations on the market—pineapple-grapefruit, apricot-orange, or pear-pineapple.

With respect to dairy products, there is much work under way on the utilization of whey which contains a high quality protein. A milk product containing essential unsaturated fatty acid is already on the market. Perhaps the time will come when a satisfactory canned single strength milk will be available and hence eliminate the inconvenience of home delivery of milk and perhaps even reduce the cost to the consumer.

We can expect new and better frozen products.

Spectacular work is underway on dried products. Already there are fruit juice powders that have promise. The present freeze-drying procedure is expensive because it requires a batch type treatment. However, should a continuous or near continuous procedure be worked out some surprising new dried products could be developed. For example, there has been some discussion by the Army of dehydrated plate dinners. Freeze-dried meat is already available in small quantities for campers, etc. Results with other products such as avocados have been promising.

Without doubt these developments will cover the full spectrum and most certainly meet the needs of changing food habits. While the cost factor will be considered, it will also be realized that the consumer has been willing to pay a certain amount for convenience and other factors of acceptance.

We can look forward to some great changes in packaging materials and procedures. There have been some rather spectacular developments in light weight plastic materials. Thus far, these have had certain limitations insofar as heat processed foods are concerned. It now appears, however, that we can expect pliable and semi-rigid plastic containers that

will withstand the heat required for processing. These packages will be lighter and likely less costly. One can visualize certain advantages from the standpoint of transportation. Above all, the plastic materials must be made of good grade materials and must be completely safe.

Continuous process for the manufacture of bread is just about a reality. If one is willing to "shoot at stars" he can visualize certain advantageous aspects of processing done on the farm rather than at the processing plant—such as reducing the moisture contents of items to be concentrated.

In brief, it appears safe to say that we have just seen the beginning, insofar as cost of production, improvement of the eating quality, convenience, nutritive value and general quality and variety of foods are concerned.

### DISCUSSION: CURRENT RESEARCH IN FOOD TECHNOLOGY

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In his paper Mrak refers to the "full spectrum approach" as the framework within which food technologists evaluate products and processes they are developing. One of the segments of this spectrum is the economic effect of technological innovation upon the firm, the industry, and the consumer. Mrak recognizes the firm effect in his repeated reference to the firm cost structure. However, several colors of the spectrum will be overlooked if food technologists only consider the cost impact of an innovation. To complete the economic sector of the "spectrum" the economic effect upon the industry and society must also be considered.

The firm's primary objective is to maximize profits within the policy framework set up in the firm. The net revenue position of the firm is of greater consequence than either the cost level or the total revenue. An innovation which is cost-increasing may also increase or decrease net revenue depending upon the elasticity of demand for the product. Therefore, the emphasis on cost-reducing innovations may not be consistent with the firm's policy of maximizing net revenue. Under certain conditions (upward movement of demand accompanying cost reductions) this emphasis on cost reduction is justified.

Another economic area that must be considered is the aggregate effect of innovations on the food industry. Food firms will not adopt innovations (new processes, packages, products, etc.) unless they increase net revenue; however, an innovation may increase a firm's profit but still result in reduced profits for the industry. For an industry, as with the firm, the effects of innovations will depend upon the price elasticity of demand.

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2. If demand is inelastic and the innovation increases total output and increases total cost, the net revenue must decline. With an inelastic demand gross revenue declines as output increases and increases in costs reduce net revenue still further.

3. If demand is inelastic and the innovation is output increasing and total cost decreasing the net revenue may increase or may decrease. Whether net revenue increases or decreases depends upon the decrease in total revenue compared to the decrease in total costs. If the decrease in total revenue is less than the decrease in total costs net revenue will increase, or vice versa.

The above examples are not the only combinations possible. They do however, illustrate that the economic effects of advances in food technology do not always result in increased profits for a particular segment of the food industry.

It is fairly easy to visualize the over-all economic effect of an improved process or increased product yields from raw materials. It is more difficult to assess the effect of specific innovations such as new products, new packaging methods or organizational changes. The adoption of such innovations may change the industry cost structure through increased costs of obsolescence, excess capacity, and diseconomies of scale due to less than optimum product turnover.

If we stopped here and left economists with the task of quantifying the economic impact of food technologists' contributions in terms of the net profit position of the firm and the industry, we would have left them with a monumental task. However, this is not enough. Before we can assess the ultimate effect of innovations in the food industry, the changes in the competitive structure and the political effect must also be considered.

Advances in the science of food technology have very definite implications for the competitive structure of the total food industry. Since the late 1940s there has been a great shift in the buying practices of retail food firms. Institutional changes and developments in food technology have made price specification buying a common practice. Further research in product standardization and quality control will probably help bring additional organizational changes in the food industry.

A continuation of the trend toward price specification buying may result in a more oligopolistic marketing structure. Many of the processes are controlled by patent rights. Also, the increased level of technology calls for increased capital outlays for entry into the industry. This combination of patent control and increased capital requirements reduces the ease of entry into the food handling and distribution business. Such a movement is presently in progress in some food processing industries.

This trend toward a concentration of volume in relatively few hands in the processing area has its counterpart on the retail buying side. Concentration of buying power is proceeding at a rapid pace, either in the form of corporate ownership or through voluntary association of retail firms. Such a combination of power concentration on both the buying and selling side may result in an oligopolistic market structure as we have in automobiles and steel today. In addition to advances in food technology and other sciences, the growth of this type of market structure will be influenced by the rulings and actions of regulatory agencies such as the Federal Trade Commission. Economists have the job of analyzing these changes and determining whether these innovations will lead to an oligopolistic industry and what the economic effect may be.

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A last point is the implication of advances in food technology in the economic-political segment of the marketing industry. When food technologists develop new products and processes they influence our political decisions as well as our economic decisions. Through this economic-political influence consumer welfare is affected, Federal milk marketing orders, for example, are political as well as economic in nature. They have become highly institutionalized and were set up as policy measures as well as for economic purposes. A single strength canned milk acceptable to housewives could result in a considerable relocation of our fluid milk production pattern. Widespread adoption, however, may be thwarted by institutionalized marketing system. Present levels of technology in refrigeration and transportation make movement of milk over large areas possible right now.

However, legislative barriers, either state or national, prevent the free movement of milk in many markets. Economists must assess the cost of our institutional and marketing system to society in order to have a basis for judging innovations. At some point the total costs of maintaining the institutionalized marketing status quo will be prohibitive. It is up to economists to show what these costs are and how the consumer welfare would be enhanced by basic changes in our economic-political market structure.

The economic effects resulting from advances in food technology are just beginning to make themselves felt. Food technologists have made great contributions toward increasing the level of consumer welfare and will continue to do so. Economists will have to make equally great contributions in analyzing the economic effect of these innovations from the standpoints of firm welfare, the welfare of the total food industry, and consumer welfare if we are to realize the full potential of the science of food technology.

# WHAT WE DO AND DO NOT KNOW ABOUT FOOD CONSUMPTION OF AMERICAN FAMILIES

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MARGARET G. REID University of Chicago

THIS ARTICLE focuses on surveys of family food consumption in the United States.¹ Annual estimates prepared by the U.S. Department of Agriculture of various foods consumed and estimates of total food expenditures prepared by the U.S. Department of Commerce provide the main descriptions of trends in food consumption. Based on market information they are nevertheless primarily descriptions of aggregate family food consumption, since consumption apart from families is a relatively small though fairly constant part of the total. Family data could be a main source of information on secular change; so far they are useful chiefly for describing conditions at a point in time pertaining to food consumption undergoing important cyclical and secular changes. To interpret the data from family surveys correctly it may be necessary to take into account the nature of cyclical and secular changes and their probable distribution throughout the population.

Factors Causing Variation in Food Consumption Among Families

The three general factors causing variation in food consumption are those common to any consumer product, i.e. preferences for and prices of various products and resources available for consumption. Many conditions are involved. Among them are the following: (1) established customs and food habits of groups such as those associated with region, national origin and religion which may affect the importance of more food compared to more of some other products (as well as relative preferences among foods); (2) forces bringing secular change in relative preferences that may have a differential effect on various segments of the population;<sup>2</sup> (3) the size and composition of households, i.e. the age and

<sup>1</sup>Much of what appears in this paper may apply to Canadian as well as American families. For a comparison of trends in Canadian and American food consumption see M. G. Reid, "Agriculture and the Health of the Nation-Economic Aspects," Agricultural Institute Review, Sept.-Oct., 1957.

<sup>2</sup> For example consumer education conveying the newer knowledge of nutrition is thought by some to have a greater effect on the young than on the old, and to be directly related to the extent of education. If so, the younger the members of a family and the higher the level of their education the more the food consumed will conform to that advocated by nutritionists rather than being patterned on prevailing customs and conventions. Because of its importance as a conveyor of calcium, the nutrient most likely to fall below the recommended dietary allowances of the National Research Council, is milk. The 1948 dietary survey gives some evidence that consumption of milk is related to education of homemakers, and this tends to be inversely related to their age. See USDA Agriculture Information Bulletin No. 132, p. 23. On the other hand a new food in early stages of diffusion may not be available in all markets simultaneously. This may lead to a difference between places.

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sex of persons and their number; (4) physiological needs related to activities, e.g. the greater calories needed by manual than clerical workers; (5) the extent to which working and leisure activities take family members away from home and other conditions affecting the extent to which meals are eaten at home;<sup>3</sup> (6) the relative price or cost of food compared to other consumer goods and of one food compared to others; (7) the current income of the family; (8) customary family income; and (9) other resources available affecting propensity to spend.

When the effect of one or more factors is being investigated, such a list may be sufficient as a reminder of what to check before assuming that other things are constant. It seems likely to be inadequate when foods are rationed, when there are food subsidies selective to certain families, when food is received as a gift or pay, or when there are boarders present in the family and their food is reported as part of household food, but their income not included in the household income.<sup>4</sup>

Something is known about each of these conditions, but income is the factor most fully investigated. Much interest in it comes from those seeking to predict future demand. Many conditions render a reliable estimate of the effect of income among families difficult. Among these are (a) inability to take into account factors affecting consumption; (b) the high degree of inter-correlation of income and other variables-including many of those listed above; (c) the nonlinearity of many interrelationships even when variables are expressed in logarithmic form; and (d) the difficulty encountered in estimating nonlinear interrelationships, and random components in income. The greater the importance of these components, the lower the elasticity of demand for food with respect to income. The last three conditions in my opinion apply about equally to estimates relating to total expenditures and to quantities of various foods. On the other hand, condition (a), i.e. the missing information, interferes more with reliable estimates of the relation of income to quantity of various foods demanded than to total expenditures for food. Food surveys do not explicitly report information on prices or preferences. Variation in these is in my opinion

<sup>&</sup>lt;sup>3</sup> This may be influenced by a whole host of things including the kind of house-keeping facilities available, the gainful employment of the wife and the time spent in food preparation. See Mississippi Agricultural Experiment Station Bulletin, No. 558, 1958.

<sup>&</sup>lt;sup>4</sup>Except in a very few food studies this has been the practice. The food-income relations observed in the early studies were much influenced by it because many families had boarders and their importance was correlated with family income. Even in the 1950 study the presence of boarders seems likely to influence food-income ratios of some sub-groups.

<sup>&</sup>lt;sup>6</sup> Some investigators of time series have used estimates of "income" elasticity of demand for food based on family surveys. See, for example, Richard Stone, The Measurement of Consumers' Expenditure and Behavior in the United Kingdom, 1920-1938, Cambridge: University Press, 1954, p. 310; and Herman Wold, Demand Analysis, New York: John Wiley & Sons, 1953, p. x.

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less likely to cause variation in total expenditures than in quantities of various foods consumed.

## Relative Prices of and Preferences for Various Foods

Dietary surveys provide estimates of quantities of various foods consumed and average prices paid. Quantities consumed are influenced by preferences, by quality of products available and relative prices of food compared to other products. Prices paid are, in part, the result of differences in quality and services provided with products, and in part represent real price differences. Food preferences and market prices are likely to differ among families, and this difference may be correlated with income. This likelihood has led to an increase in the size sample in order to stratify families in various ways, e.g. by type of community, by region and by family type as well as by income. For example, when families are separated by type of community, the direct relation between income and average price6 of food is reduced, so also is the inverse correlation between income and the percentage of adults doing heavy manual labor. When families are stratified by region they are in part stratified by relative prices and by food preferences. The geographic specialization of production for the national market and differences in cost of products drawn from local sources are such that an important difference in relative prices among regions is to be expected. These will determine the quantity of various foods consumed.

Evidence on differences in food preferences comes from observing food habits of families under various circumstances, including their behavior when they migrate between regions. Such evidence gives good reason to believe that food preferences differ between the deep South and the North on such things as beef v. pork, sweet milk v. buttermilk, corn v. wheat products, sweet v. Irish potatoes, and mustard greens v. spinach. There is also some indication that the Pacific Coast region is developing a unique set of food preferences. Definitive evidence however awaits a separation of price and income effect from the effect of preferences. There appears to be no doubt about differences in food preferences between the North and the South. Such differences together with income by region are such that any estimate using data for the nation in general will be heavily weighted at the low incomes with food preferences of the South<sup>7</sup> and at high incomes with food preferences of the

<sup>&</sup>lt;sup>6</sup>Farm families draw a considerable amount of their food from local sources including a good deal from the farm operated. Such food is relatively low in price in that income is foregone, rather than sale. Such prices contribute to a difference in food consumption. Similiar factors operate between rural nonfarm and urban places. Having a garden and keeping chickens is more common in rural nonfarm than urban areas.

For the nation in general, of urban families of two or more persons reporting in the 1955 dietary survey, 52 per cent of those with incomes under \$2,000 were in the South as were 12 per cent of those with incomes of \$8,000 or more. See Study of

North. As the regional difference in income narrows regional difference in preferences will have less effect on national estimates of quantity of various food consumed by income among families.

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The national survey of 1955 should advance knowledge on effect of relative food preferences and prices. It reports data on separate foods stratified by type of community, i.e. urban, rural nonfarm and rural farm; and by region, i.e. Northeast, North Central, South and West; and for families of two or more persons classed by annual income. However, even within region<sup>8</sup> and type of community, preferences may be correlated with income—because both income and preference differ by race, national origin, occupation and education.

Family type, i.e. number of persons present, their age and sex, seems likely to affect food preferences. Stratification by number of persons or estimating per capita consumption<sup>9</sup> in relation to per capita income does not remove the effect of preference related to age. With family size held constant the average age of members seems likely to rise with income. If so, food need per person seems likely to increase with income, but the increase may differ between such foods as milk, cereals and meat. <sup>11</sup>

I have examined urban family per capita consumption of a few foods likely to differ by region, race, and national origin. These are pork, beef, margarine, butter, and potatoes. Important differences in the level of consumption at a given income occur within regions as well as between

Consumer Expenditure, Incomes and Savings, tabulated by the U. S. Bureau of Labor Statistics (BLS) for the Wharton School of Finance and Commerce, 1956.

<sup>8</sup> Each region may have its own pattern of preferences correlated with income. For example in the South any differences in food preferences between white and Negro families is correlated with income, and in the West food habits originating in Mexico are likely to have a similar correlation.

<sup>9</sup> In addition it does not take into account the economies of scale that relate to food preparation. These may affect such things as chops v. roasts of meat and processed

v. unprocessed foods.

<sup>10</sup> Many conditions contribute to this relationship. There is, for example, a tendency for households with young children to be relatively low in the income distribution. This occurs in part because birth of children occurs when fathers are likely to be below the peak of their age-income cycle, and in part because the presence of young children intereferes with the mother contributing to the income of the family. Families with older children concentrate at the higher income point in part because there are more multi-earner families at this stage. In the 1955 dietary survey the percentage of persons aged 16 to 55 years tends to rise steadily with income, from 32 per cent at income interval \$2,000 to \$3,000, and 51 per cent at incomes of \$8,000 to \$10,000. At the same time the percentage of members under four years of age falls from 12 to 6 per cent. See U.S. Department of Agriculture Household Food Consumption Survey 955, Report No. 6, 1956 and later. The BLS 1950 survey shows a similar concentration of adults at high incomes and of children at low incomes. (Data are shown in Vol. II, op. cit., table 14.)

<sup>11</sup> For some evidence bearing on the effect of household composition see M. G. Reid, "Food, Liquor and Tobacco," *America's Needs and Resources*, Frederic Dewhurst *et al.* 1955, p. 143; and USDA Agricultural Information Bulletin 132, *op. cit.*,

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them. Reliable estimates of the elasticity of consumption of various foods with respect to income continue to be difficult although 1955 dietary survey data are a marked improvement over earlier data. The assumption of constant prices<sup>12</sup> and/or preferences with respect to income in many sets of data is obviously invalid.

## Elasticity of Total Food with Respect to Income

Main interest has centered on total food expenditures with respect to income. Many estimates have been made since Engel first observed that increase in income tends to bring a decrease in the percentage of income going to food. His findings continue to be sustained, but there is, however, an appreciable range in estimates. Burk, for example, reports an elasticity of food with respect to income for urban families of .58 for 1941, .33 for 1944 and .31 for 1947.<sup>13</sup> Tobin reports a coefficient of .65 for urban families for 1941.<sup>14</sup> Many other estimates have been made—some higher and some lower.<sup>15</sup> It may be that these differences represent variation in basic tendencies. This can only be determined if the presence of other factors is thoroughly investigated.

An important first step toward greater homogeneity of variables seems to be recognition of the complexity of total food expenditures as an expression of consumer choice among alternatives. They are affected by the quantity and quality of the separate foods and the amount of services provided, including meal service. Meals away from home include those at work, at school, or on vacation. Some of them are closely identified with recreation in the minds of consumers and may include the price of costly entertainment. Such things fall in a class very different functionally from expenditures for pounds of meat, bread, vegetables and fruits. Food in this sense performs a relatively homogeneous set of functions. Alcoholic beverages represent "foods" serving with a unique role—rather far removed from nourishment as such, and probably closely identified with

<sup>&</sup>lt;sup>13</sup> The price of beef compared to pork was examined for four regions and two types of communities, i.e. urban and rural nonfarm, for households with an income between \$4,000 to \$5,000. The higher the average price paid for beef relative to that for pork the lower was the quantity of beef consumed per pound of pork. This negative relation was quite pronounced for the two types of communities in three regions. There was considerable difference among regions in relative price. Some of this may have been related to quality. (Data examined are those in tables 1, 2 and 10 of the published reports.)

<sup>&</sup>quot;Marguerite C. Burk, "Changes in the Demand for Food from 1941 to 1950,"

Journal of Farm Economics, Aug. 1951, p. 285.

"James Tobin, "A Statistical Demand Function for Food in the U.S.A." Journal of the Royal Statistical Society, Series A (General) Part II, 1950, Vol. CXIII, Part II,

<sup>&</sup>lt;sup>18</sup> A good summary of coefficients derived from family data is provided by T. W. Schultz, *Economic Organization of Agriculture*, New York: McGraw-Hill, 1953, pp. 51-55

<sup>&</sup>lt;sup>10</sup> Food expenditures do not include vitamin pills even though these are thought of by many consumers as a food substitute.

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recreation. The separation of food at home and away from home seems to be an important first step in refining analyses. Furthermore in extending knowledge of factors causing variation it seems likely that considerable advance can be made: <sup>17</sup> (a) by investigating the effect of age and sex of persons as well as number of persons in households and (b) by taking into account the effect of random components in income.

Table 1. The Elasticities of Food with Respect to Income for Two-Member Urban Families

Study <sup>19</sup>	all food <sup>20</sup>	at home <sup>21</sup>	Coefficient for food at home as a ratio of that of all food
1955	.391	.282	72
1950	.476		61

Both the dietary survey of 1955 and the food consumption data from the 1950 urban study make it possible to introduce more controls than were previously possible. One question of interest is the extent to which these two surveys indicate the same food-income curves. Thus for families of two the dietary survey of 1955 shows a lower elasticity of total food expenditures with respect to income than does the survey of 1950, i.e. lower by 18 per cent. However, the two sets of data show almost identical

<sup>37</sup> I have long suspected a difference by occupation because of difference in food needs, but so far I have not isolated such effect from the 1950 data. The 1935-36 study consumption study does indicate some tendency for the food-income ratio to be higher for wage-earner than for professional families when income and family type was held constant. See M. G. Reid, "Food, Liquor and Tobacco," op. cit., p. 127. However I now suspect that this difference may have been the effect of the greater underunemployment among wage-earners than professional families.

Average expenditures for food exclusive of alcoholic beverages for 28 cells of consumer units with two or three persons, standardized for region, income and number of persons, in the large cities of the three regions, in 1950, were as follows: Salaried professional—\$1,069; Skilled wage-earners—\$1,085; Unskilled wage-earners—\$1,019. These data are from Vol. III, Table 16. It may be that the tendency for manual workers to spend a higher percentage of a given income for food is obscured by the distribution effect. See footnote 22.

tion effect. See footnote 22.

18 These elasticities relate to variables expressed in log form. This assumes a con-

stant elasticity at all income levels.

The national urban data for 1941 do not permit an estimate of food at home by family size. Fox, however, presents an estimate for all families using per capita food expenditures in relation to per capita income. The elasticities of food expenditures with respect to income are as follows: all food .42, and that at home .29. See "Factors Affecting Farm Income, Farm Prices and Food Consumption," Agricultural Economics Research, Vol. III, July 1951.

<sup>20</sup> These estimates relate to value of food consumed including alcoholic beverages as reported in the 1955 dietary survey and to total expenditures for food and alcoholic

beverages as reported in the 1950 survey.

The For both studies these estimates relate to purchased food only. The studies differ slightly in the treatment of alcoholic beverages. The estimate for 1950 excludes alcoholic beverage reported as such, whereas alcoholic beverages are completely merged with other food in the 1955 survey.

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elasticities of food at home with respect to income. A mixture of conditions probably contributed to the greater effect on income elasticity of food away from home in the 1950 survey. The 1955 survey excludes any families not eating<sup>22</sup> a considerable portion of their meals at home during the survey week which was confined to the spring season. The latter condition may be quite important. The food expenditures of all consumer units during the spring of 1950 might have shown an income elasticity of food expenditures with respect to income quite similar to that of the 1955 survey. An important part of food away from home probably occurs in the summer months when vacations are most common. If such food concentrates at high income levels it could account for the differences observed between the surveys in elasticity of total food expenditures with respect to income.

In both surveys food away from home had an important effect on the coefficients of income elasticity of total food expenditures. Thus there is a question as to how such coefficients should be interpreted. An estimate of demand for food influenced largely by food away from home does not seem likely to be a useful estimate of demand for any single thing. If one could assume that food away from home is not a substitute for food at home then one could assume that the demand with respect to basic foods as they come from retail stores is much the same for these two surveys. Insofar as substitution occurs, it will tend to depress the coefficient of elasticity of food at home in the 1955 study less than in the 1950 study with families grouped by income. The intercorrelation of the variables is such that a reliable estimate of the effect of elasticity of demand for food at home with respect to income, holding constant importance of food away from home, is unlikely.

Another feature of these food-income curves that is of interest is the higher level of the 1955 curve over the 1950 curve.<sup>23</sup> At every income level food expenditures were higher in 1955 than in 1950. If the variables are adjusted for price change<sup>24</sup> the difference in level is narrowed but

<sup>&</sup>lt;sup>12</sup> The 1941 national survey reports food separately for housekeeping and nonhousekeeping families. These indicate that the elasticity of food expenditures with respect to income is greater for nonhousekeeping than for housekeeping. This difference occurs in part because some of the nonhousekeeping consumer units are domestic employees who receive some meals as pay. When food in kind is taken into account the difference in the slope of food-income curves by housekeeping facilities is quite small. See U. S. Department of Labor, Bulletin 822, 1945, table 21A.

<sup>&</sup>lt;sup>20</sup> Dorothy S. Brady and Rose Friedman, "Savings and the Income Distribution," Conference on Research in Income and Wealth, Vol. X, National Bureau of Economic Research, 1947, pp. 250-265, were the first to present a systematic analysis of the relative level of consumption-income curves. They noted that total savings, and conversely total expenditures, as a percentage of income was similar at the same position in the income distribution.

Adjustment was made with the Consumer Price Index. From May of 1950 to May of 1955 all index items rose 12.7 and that of food 12.3 per cent.

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not removed. Analysts are thus confronted with the question as to why the level of food expenditures at a given income, quite apart from the effect of price change, is higher in 1955 than in 1950. Is this a secular change, or is it something else? It seems likely that the difference is probably related to something else because it occurs in both the 1955 and 1950 data concerned with family sub-groups in 1955 and 1950, In my opinion when price and family types, and perhaps occupation, are held constant, such differences in level observed are in large part the result of random components in income.25 This will cause some families to be ranked in an income bracket below their true economic status and others to be ranked above it. This leads to a correlation between average food expenditures of the group and food expenditures at any given income. At a given dollar income expenditures for food of groups of families is correlated with average food expenditures of the group in general. whereas food-income ratios at a given percentile position in the distribution tend to be much the same.26

<sup>25</sup> Reporting error is one condition giving rise to a random component in income. Knowledge concerning it has increased greatly over the past 10 years. I have assembled much of it in an unpublished manuscript. Vague recall or careless guessing and desire to impress with overstatement or to conceal sources of income undoubtedly lead to random reporting errors. Comparison of income for the same period from matched samples as well as characteristics of data where a complete financial account is secured, all testify to the presence of random reporting errors. This condition results in a tendency for income to be understated at low income intervals and overstated at high income levels.

Short-run income change which puts some families above their typical income in some years and below it in others will also constitute a random component. Such income change has come to be referred to as negative and positive transitory income. It is important in determining income of any one year as is indicated by the number of full-time earners reported in the 1950 urban survey. For urban consumer units the average rises from .3 earners for those with incomes under \$2,000 to 1.5 for those with incomes of \$7,500 to \$10,000. See Vol. I, op. cit., Table 3. This characteristic of the data occurs for most subgroups of consumer units for which data are reported. There seems no reason to suppose that the 1955 and the 1950 surveys differ in this respect.

Recognition of this characteristic of incomes appears to be bringing considerable change in consumption analysis. The theory of the interrelationships involved has been developed by Milton Friedman, A Theory of the Consumption Function, New York: National Bureau of Economic Research, 1955 and by Franco Modigliani and Richard Brumberg, "Utility Analysis and the Consumption Function," Post-Keynesian Economics, edited by K. K. Kurikara, 1954, pp. 383-436. Both of these analyses include empirical evidence. Additional evidence is reported by Marilyn Dunsing and Margaret G. Reid, "Effect of Varying Degrees of Transitory Income on Income Elasticity of Expenditures," Journal of American Statistical Association, June, 1958, pp. 348-359. The theories have given rise to considerable controversy. See, for example, Irwin Friend and I. Kravis, "Consumption Patterns and Permanent Income," American Economic Review, Paper and Proceedings, May, 1957, pp. 526-555; and H. S. Houthakker, "The Permanent Income Hypothesis," American Economic Review, June, 1958, pp. 396-404. In my opinion the bulk of evidence leaves no doubt that the permanent income hypothesis will be useful in analyzing family food data.

\*\*Such difference in level of food expenditures at a given income with family size

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The correlation of family types with income has long complicated estimates of income effects. The types are so numerous that no survey has yet provided more than crude stratification. The simplest measure of type is number of persons per family. The 1950 data show the elasticity of food expenditures with respect to income to be higher for units of six than for two persons. The coefficients for urban families in 1950<sup>27</sup> are as follows:

TABLE 2. ELASTICITY OF EXPENDITURES WITH RESPECT TO INCOME.

Number of persons	All food including alcoholic beverages	Food at home	Coefficient of food at home as a ratio of all food
one <sup>28</sup>	.577	.061	11
two	.476	.291	61
three	.482	.319	66
four	.500	328	66
five	.577	426	74
six or more	.607	486	80

Thus the coefficients for all food is 28 per cent higher for families of six or more than for families of two, and for food at home it is 68 per cent higher. It seems highly probable that these differences are related to age of members by income level.

held constant is considered by Jean Crochett, "A New Type of Estimate of the Income Elasticity of Demand for Food," American Statistical Association, Proceedings of the Business and Economics Statistics Section, Sept. 1957, p. 118, and by Burk, ibid., p. 106. My examination of such differences in level of food-income curves leads me to believe that it is largely a function of what we term the distribution effect. This in turn may be related to the random components in the income distribution. See footnote 23.

in Similar coefficients were estimated for the urban set of the 1955 dietary survey. The coefficients of elasticity of total food with respect to income were found to vary directly with number of persons when the importance of food away from home was taken into account. This finding differs from that reported by J. A. C. Brown, "The Consumption of Food in Relation to Household Composition and Income," Econometrica, October, 1954, p. 454. He concluded that "all types of households reacted to variation in income with approximately the same elasticity." He does, however, go on to add: "There is a tendency for households containing adults and adolescents only to show a greater elasticity than those containing children and infants." It may be that Brown's findings were influenced by random components in the income. His description of method of securing income data leads me to suspect that random components were very important, and that they probably were related with the composition of the household. It is of some interest to note that his partial income elasticities holding household type constant were directly related to the correlation of income and food expenditures. This is the relationship to be expected if there was a random component in income that lowered the regression of food with respect to income and at the same time lowered the coefficient of correlation of the two variables.

\*\*The one-person units have certain unique features, e.g. the coefficient is relatively high for total food expenditures and low for food at home. This indicates that the coefficient for food away from home together with alcohlic beverages is very high. One thing that contributes to this is the increase in the proportion of units eating all

There are many other factors correlated with income that affect  $f_{00d}$  expenditures. Knowledge grows as the effect of these is understood,

## Improving the Estimates of the Income effect

Knowledge is of two general types: (a) observation and description and (b) understanding of variations observed. We are rich in description. The development of the theory and practice of sampling has made this possible. Yet we are poor in understanding. This is not surprising. Total food relates to a heterogeneous set of consumer functions which respond differently to various conditions. As investigation proceeds, the lack of important facts in the current stock of data will become more obvious: in addition, the data will prove inadequate to permit the stratification needed. The usefulness of the stock for estimating the income effect might be improved by such things as the following: (a) additional information, e.g. on family resources other than current income, the extent to which employment of homemakers increases the number of meak eaten out, the extent to which food eaten away from home is related to recreation, vacations and school and their conditions likely to be associated with food preferences; (b) sets of data from the same consumer units in successive years to confine estimates to those reporting approximately the same income,29 and (c) increasing the size of sample so that

their meals out as income increases. This is indicated by a decrease in the proportion of units having any expenditures for meals at home. This in turn may be related to the fact that a high percentage of one-person units with high incomes are males. The percentages reporting some expenditures for food at home are as follows: 90 per cent of those incomes under \$1,000 (including 30 per cent of all one-person units), and 7.2 per cent of those in the top quarter of the income distribution. In addition a marked increase with income occurs in the importance of alcoholic beverages. For example the percentage of total food expenditures reported going to alcoholic beverages for units of one- and of two-persons is as follows:

Income	one-person	two-persons
Under \$2,000	2.1	2.0
\$10,000 and more	21.2	12.8

The marked increase with income for the one-person units may be largely a function of sex. It may also reflect less underreporting when a person reports for himself as

occurs for one-person units. Vol. III, op. cit.

This should make it possible to reduce greatly the random component in income. Other methods can of course be used. Friedman's permanent income theory led him to conclude that average total expenditures for all items by income interval provides a good index of the average economic status of families. If so then it could be used as a measure of income in order to estimate elasticity of food with respect to income. Such a method was used by Houthakker in estimating the elasticity of total food expenditures with respect to income in 1950 with family size held constant. He derived an estimate of .693. H. S. Houthakker, "An International Comparison of Household Expenditure Patterns," *Econometrica*, October, 1957, p. 541. This is only one of the many proposals where validity needs to be further tested. I doubt that it will prove satisfactory even if size and composition of units were carefully controlled, because of variation among consumer goods in response of expenditures to shortrun income change.

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further stratification is feasible. For example, use age as well as size, employment status of members including the housewife, and confine the analysis to a single city to eliminate possible price effects.

Such things would tend to increase the cost of the data. The question therefore arises as to whether refinement of estimate is worth the additional cost. It may be that the crude estimates currently available as to income effects are adequate for most purposes. There seems no doubt that the increase in pounds of food and nutrients with income is very low, that some of the increase in food expenditures occurs because of rise in quality and that the income elasticity of the bundle of things now arbitrarily defined as food is appreciably less than 1.0. With data available the estimate probably can be improved somewhat. To do so careful attention needs to be given to the characteristics of what is being measured, to the heart of the scientific method, and to the tools of estimation, i.e. statistical methods. The issue of how great accuracy is needed depends on why the knowledge is needed. Certainly a refined estimate of the income effect may not improve a forecast unless it is matched by a refined estimate of cross elasticity of demand for various foods with insights on changes other than prices such as those wrought by the new technology and by consumer education.30

Those striving to improve the estimate of income effects on food consumption can take some comfort from the difficulties encountered by others striving to estimate its effect on total consumption expenditures, and from the observation by Lynd that "The stubborn unavoidable fact that confronts the social scientist at every point is the presence, in every institutional trait that he seeks to analyze, of a subtly graded, unevenly distributed and continually changing array of behavior." 31

a Robert Lynd, Knowledge for What? p. 29.

# DISCUSSION: WHAT WE DO AND DO NOT KNOW ABOUT FOOD HABITS OF AMERICAN FAMILIES

### A. C. HOFFMAN Kraft Foods Company

Dr. Reid has given us an excellent description of family food consumption data and their reliability (or the lact of it) for analytical purposes. I should think her paper would be "must" reading for anyone using such data for research purposes.

I want to make it clear at the outset that I do not question the value

<sup>\*\*</sup>For a comprehensive variation of the problems of estimating changes in the demand for food see Karl A. Fox, "Changes in the Structure of Demand for Farm Products," Journal of Farm Economics, August, 1955.

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of the family food consumption data for showing general patterns of food consumption. However, I cannot escape feeling these data are too crude for the precise measurement of many factors affecting food consumption and marketing, and should not be expected to give us all the answers sometimes sought in them.

As Dr. Reid points out, family food consumption data have two main uses. The first is for the purpose of demand and market analysis; the

second is for measuring dietary and nutritional standards.

A vast amount of work in data gathering and analysis has gone into the computation of income elasticities for food. To use Dr. Reid's words, there is an "appreciable range in estimates" obtained from such analyses. One very competent analyst came up with income coefficients for food consumption in urban families ranging from .58 in 1941 to .31 in 1947; another analyst found a coefficient of .65; and "many other estimates have been made, some higher and some lower." On the basis of these and similar findings, I don't know how one would go about describing with any mathematical precision just what the income elasticity for food really is—unless one were to strike a weighted average of all the coefficients which have been computed, weighting each coefficient on the assumed competence of the analyst who computed it. I am not sure we have yet gotten ourselves much beyond Engel's common-sense observation that the poor necessarily spend a larger proportion of their income for food than the rich.

Much interest has attached to the relationship between income and per capita consumption of individual foods. Again these general relationships are worth knowing, but their usefulness for demand and market analysis can be overemphasized. Most companies having even a rudimentary knowledge of the market for their products already know what these general relationships are; and the more sophisticated of them usually make more specific consumer and market research studies to suit their particular purposes in planning their sales programs.

As regards the use of income elasticities for purposes of analyzing composite demand, there are undoubtedly some ascertainable relationships here. But I think he would be a bold analyst indeed who would try, by the use of income elasticities, to predict the effect of changes in

total national income on food consumption patterns.

The second major use of family food consumption data is to give some measure of the nutritional adequacy of diets over a period of time, and for different groups in the population. The general assumption seems to be that if the poor eat as the rich eat (as indicated by the family food consumption data) then health standards would be greatly improved and the farmer would be better off to boot. As a broad generalization, there

 $_{\mbox{\scriptsize is a}}$  basic truth in this, but the matter of good nutrition is by no means this simple.

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The term malnutrition connotes undereating to most people, and this is the phase of the problem which receives most attention from public agencies. During the 1930's there undoubtedly was a significant segment of the American population which was underfed in some respects; and for a minor segment of the people this is still true. But I think it is correct to say the consensus of the medical profession today is that we do ourselves more harm by overeating than by undereating, and this may have been true even in the 1930's. We pride ourselves in America that we eat well, in terms of a large proportion of animal products in the diet. But let us not be too literal about this in terms of health. The medical profession-some parts of it at least-has begun to associate the intake of certain fats and cholesterol with arteriosclerosis, and they even tell us that it is possible to enjoy the best of health without eating as much protein as most of us do. For economists who have more faith in statistics than in the medicos, there is the further evidence that the peoples of places like India and China-whatever their problems of getting enough of anything to eat-at least do not fall over dead so frequently from strokes and heart disease.

Good nutrition is a many-sided and complex thing. It seems to me that we may have overemphasized income as a factor in it. Many things affect the way people eat, apart from income. Partly it is a matter of family training and traditions; some families provide themselves with a wholesome and well-rounded diet on a relatively small amount of money, while others wouldn't eat properly regardless of income. People also differ with respect to what they choose to spend their money for. Some choose to spend money for good eating in the sense that they prefer their food in the more tasty and expensive forms; others eat simpler food and spend the money thus saved for other things, equally worthwhile. Among older people who live alone, a factor which sometimes leads to improper eating is simply the fact that there are no young appetites around to warrant the trouble of preparing well-rounded meals. If these things are true, then we need to emphasize training and education for proper nutrition, as well as income.

Dr. Reid alludes to several things affecting food consumption, and the difficulties in using family food consumption data to study these effects.

One of these developments is the increase in "eating out." I personally feel that family food consumption data should not be expected to give us any very specific data as to what kinds of food people consume when they eat out, how much they pay for it, and what proportion of the money

spent for eating out is represented by nonfood elements, which more properly come under the heading of recreation. If the problem is to find out what the "old man" eats for lunch during the work day, the easiest way to get at this is probably to get data from institutional feeding establishments where a great proportion of working men and white collar people eat their lunches. In the case of eating out for recreational purposes, the expenditures may have very little relation to food consumption.

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Another important development, which may or may not affect the patterns of actual food consumption, is the trend toward the so-called convenience foods. If we are to assume that families tend to spend only so much money for foods, their buying of the more expensive convenience foods would tend to cut down their food intake. I doubt that this is true, and such over-all data as are available would tend to indicate that it is not. It could, I think, as plausibly be argued that these convenience foods tend to give us a better and more varied diet than the housewife would prepare for her family if she had "to start from scratch" in food preparation. However this may be, it would be very difficult to reach conclusions about this problem on the basis of the family food consumption data—at least in their present form.

Don't think that I regard the family food consumption data as largely worthless. I do not. But I do think that we sometimes try to gain from them more than they should be expected to tell us. There are many factors regarding food consumption and the demand for farm products which require more specific studies.

# NONAGRICULTURAL USES OF RURAL LAND AND WATER

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Chairman: Gladwin E. Young, Soil Conservation Service, USDA

# THE EXTENT AND SIGNIFICANCE OF NONAGRICULTURAL USES OF RURAL LAND AND WATER

Hugh A. Johnson and Hugh H. Wooten<sup>o</sup> Agricultural Research Service, USDA

## Historical Background

THE FIRST white settlers in North America made hardly a scar on the edges of the forests or a dent in the vast resources of the continent they invaded. Today, nearly 350 years later, their heirs have moved from the simple subsistence economy of the first settlers to the highly complex economy we know today. Large segments of its population are entering an era of urbanization unrivaled anywhere in the world.

The people of North America can take justifiable pride in their achievements. But we must recognize the changing pattern in our uses of land and water resources. Most of the data developed in this paper apply specifically to the United States. But Canada is proceeding along much the same pattern and is faced with many of the same problems.

The population of the United States now totals nearly 175 million people, and the usual projections are that we will reach at least the 350 million level (double our present number) within another 50 years.

Before 1890, population doubled every quarter-century; its major characteristic lay in its westward migration across the continent. After 1900, people settled more frequently in eastern and central cities than in rural areas. Urbanization in the United States started slowly but gained momentum during the last century. In 1800, only 6 per cent of our population lived in urban places. This proportion increased to 40 per cent by 1900, and to an estimated 67 per cent in 1958. We have become an urbanized nation.

As late as 1900, one farm worker produced only enough food for himself and six others. His productivity has risen, particularly since 1940, until in 1957 one farm worker supplied the food and fiber needs of 22 persons. From 1870 to 1955, workers in agriculture declined from 50 per cent of the total labor force to about 10 per cent. Improved technology, both on and off the farm, has contributed greatly to the reduction in the

<sup>&</sup>lt;sup>6</sup> The views expressed in this paper are those of the authors and do not necessarily represent those of the Farm Economics Research Division, Agricultural Research Service, on the USDA.

amount of labor needed to produce agricultural products. Transfer of many processing jobs from the farm to off-farm sites has also been important.

Our increasing output per worker has caused a rise in specialization, in nonfarm pursuits, and in farm production. Our wants and our needs have changed. The relative importance of food and fibers has declined in relation to the other things grouped under "services" in the total demands we place on land resources.

## Major Uses of Land

Let us look at the land area. Continental United States contains about 1,904 million acres (excluding Alaska). This is divided roughly into the following uses: less than 19 million acres, or slightly less than 1 per cent, are urban; 1,724 million acres, or 90 per cent, are in some form of agricultural use including grazing and forestry on public lands, and farmsteads, farm roads, and lanes; and the remaining 161 million acres, or roughly 9 per cent, constitute all other uses of our land.

The area in farms has expanded by some 200 million acres since 1920, despite the slight change in acreage of cropland in total or by areas. The expansion was mainly a statistical realization of accomplished fact, a change in land ownership and control, not a change in land use. Where formerly farmers had much free grazing on public, railroad or private lands, pressures to maintain long-term control have encouraged land enclosure within farms and ranches by means of leases, purchases and

permits.

There is a lot of slack in these figures. They cover up multiple uses and they obscure significant regional differences. For example, the 615 million acres of forest and woodland shown as agricultural lands include more than 200 million acres of county, state, and national forests that provide important recreation, water conservation and storage, flood control, watershed protection, and streamflow regulation benefits for urban peoples. The 634 million acres of grassland and other nonforested pasture and range also include about 200 million acres of public land. The agricultural land figures also include significant acreages, particularly in the East, the Lake states, and the South, where ownership and actual use are mainly of nonfarm nature. Provision of food, services, and shelter for summer vacations and winter sports enthusiasts are major occupations of a large number of "farm families" and the major land use of many acres carried as farm land.

Approximately 10 million acres are occupied by rural villages and towns having populations of 100 to 1,000 and thus not tabulated as urban areas. The estimated acreage in these villages and towns is now scattered among other major uses of land, such as forestry and grazing.

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Our major concern about land uses in this paper, however, is with the 161 million acres of nonagricultural rural land. About 81 million acres are in intensive special uses, 25 million are in transportation—roads, railroads and airports, 23 million are in national defense and atomic energy areas, 28 million acres are in dedicated parks and forests or wildlife areas, 4 million are in flood-control areas, and the remaining million are in state institutional, and miscellaneous uses. The remaining 80 million acres include deserts, sand dunes, bare rock areas, and marshes not used as military areas, parks, or wildlife areas.

In addition to the dedicated parks and wildlife areas, an estimated 200 million acres of private and public lands have high supplemental values for recreational purposes. These areas include many sites in the Lake, New England, Appalachian, and Western states, and along the eastern, western, and southern seashores. These large recreational areas intermingled with forest and farm regions do not include the many thousands of farm ponds, stream banks, mountain meadows, and woodland glades that provide picnic spots here and there among the farms and ranches of the country.

Land has value only as it has some productive use. The colonial settlers were agrarian. There was planty of land. It was only as population expanded and as surplus products piled up that trade, industry, formal education, and public services could develop. At the same time, it was only as people began living away from the land that recreation and conservation became significant factors in land use.

The major outlines of American land use were well established by 1910 or 1920, although adjustments continue in response to economic conditions and improved knowledge of biologic balance. Under dollar pressure, we still plow the semiarid plains; we have pushed northward against the frost barrier; and we have left abandoned farms in New England, the Middle Atlantic states, and large areas of the South. Lands that once could support a subsistence economy were not able to support commercial agriculture. For many of these areas, agricultural adjustment must be toward less intensive uses more nearly in keeping with the inherent abilities of the land to produce economically desired goods and services.

Ordinarily, urban and transportation areas are in competition most directly with agriculture for the use of level and fertile land. Such related uses as open-country industrial sites, nonfarm residential and commercial sites in rural areas, strip mines, quarries, cemeteries and golf courses, which are included in other land use categories, also compete frequently for good farm land. Recreational uses often compete successfully for less desirable farming areas, provided the areas have relatively unspoiled natural features conducive to rest and fun.

## Increase in Special Use Areas

From 1945 to 1954, the acreage in urban areas, highways, airports, and reservoirs increased on an average of about 831,000 acres per year. Urban areas accounted for 395,000, or 48 per cent, of the increase; reservoir areas accounted for 360,000, or 43 per cent, although about half this area will become water surface eventually; highways for 78,000 acres, or 9 per cent; and airports for 5,000 acres, or less than 1 per cent. The area occupied by railroads decreased by about 7,000 acres each year during this period, or faster than land was taken for airports.

The acreage in wildlife refuges grew at the rate of 455,000 acres per year from 1945 to 1954 and park areas grew at about 100,000 acres annually. These trends were considerably above the long-term average for wildlife areas but were probably below the average for parks. The average increases in highway and airport areas in 1945-54 were low compared with the indicated rate of increase in these areas from 1955 to 1960.

National defense agencies expand and contract their holdings within wide limits. Rapid expansion occurred during World War II. This was followed by disposal of some types of surplus lands and facilities and acquisition of other areas, which continues during the adjustment to the atomic and jet age. Net acquisitions have averaged about 138,000 acres annually since 1950.

Flood-control works have taken an average of 133,000 acres, and about

100,000 acres are required for all other miscellaneous uses.

Not all of the land occupied by these nonagricultural uses is tillable, and many of the uses compete very little with intensive agriculture. Often, part of the tillable portions are leased to farmers, and limited grazing, forest harvest, recreation, and other regulated uses are permitted.

The regional distribution of these special-use areas provides further insight for future adjustments which must occur if all of society is to receive optimum benefits from the publicly owned forests, parks, playgrounds, and defense areas, and if the costs of necessary public services related to public land use are to be held within reasonable limits.

Urbanization already controls the specific land use in one belt running from Boston to Washington, D.C. It is approaching rapidly in the Hudson-Mohawk region of New York, in the Pittsburgh area of Pennsylvania, in parts of the Ohio Valley; in a belt running along the south side of Lake Erie through parts of Ontario, Michigan, and Illinois and up the west shores of Lake Michigan into Wisconsin; in the Seattle-Tacoma area of Washington and the Vancouver area of British Columbia; in the Los Angeles and San Francisco Bay sectors of California; in the southeastern Piedmont; and along the Gulf Coast. Completion of the St.

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tion east the cen rap Lawrence seaway could provide impetus for further growth along the lakes and on the St. Lawrence itself that might well produce another concentration of urbanization.

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The availability of resources to an economy or a region is important in the level and kind of economic development that can be achieved. We know that desirable changes within agriculture often are postponed because of limitations in land quality, labor, or capital goods. Agriculture is passing through a major revolution within which land plays a less important role. That is, land is becoming more exchangeable with other factors of production (labor, machinery, fertilizer and seed).

## Population and Nonagricultural Land Uses

Regionwide comparison of nonagricultural land uses provides insight into the pressures man places on land areas. Population in the United States is distributed unevenly. The 16 eastern states with 37 per cent of the population have 13 per cent of the land area and 16 per cent of the land in nonagricultural use. Agriculture, including cropland, grassland, forest, and woodland, still accounts for 84 per cent of the land use in this region. At the other extreme, the 11 western states have only 14 per cent of the population, but 40 per cent of the land area. Ninety per cent of the western states is in cropland, grazing or forest uses, which leaves only 10 per cent for other purposes.

Population in the nine southern states comprises 19 per cent of the United States total and is distributed over 22 per cent of the area; 92 per cent of the land is classified as in agricultural and 8 per cent as in nonagricultural uses. The 12 central states have 30 per cent of the population distributed over 25 per cent of the area, and 90 per cent of the area is classed as agricultural. These examples show the relative distribution of people and land.

The percentage distribution of nonagricultural land uses in rural areas is closely related to concentrations of total population. Populations in the East have greater density than those in the South, chiefly because farm sizes are smaller and the average size of urban and industrial concentration is larger in the East. The central and western regions have concentrated populations in newer urban areas about in proportion to their share in the national urban picture.

Rural transportation mileages and acreages are related to concentrations of population and also to historical land settlement patterns. The eastern and southern parts of the United States have relatively less of their nonagricultural lands in roads and railroads compared with the central and western regions. The rectangular survey and the push for rapid settlement through provision of transportation before settlement, coupled with later agricultural products of high value to be hauled to

distant markets, resulted in an overextension in local feeder roads, par-

ticularly in the central region.

The acreage in national and state parks is concentrated in the western land-grant states and in rougher areas of the East and South. Purchases from private owners and transfers of tax-delinquent lands were used in the older sections to build up these holdings. Wildlife areas were developed, first, to protect the birds and animals, and second, to provide recreation for people. The proportionate distribution of acreage for this use between regions matches closely the total land distribution.

National defense and atomic energy holdings are concentrated heavily in the West, as these agencies could get the large acreages needed from public domain or relatively cheaply through purchase. These uses are related roughly to the residual acreages in miscellaneous classifications—raw mountain peaks, deserts, sand dunes, swamps, and unusable shoreline

areas.

Flood-control lands are concentrated in rural areas along the Missis-sippi, Missouri, and Ohio Rivers and their tributaries. Flood control is less of a problem in the West because precipitation generally is lower, there are relatively fewer developments to be damaged, and the large multipurpose dams on major rivers include flood-control features. Dams, walls and levees have been found to be better adapted to flood protection in urban areas already built than large floodway and water storage areas that use big blocks of land.

# Future Demand for Special Use Areas

One economic consultant writing in the May 1958 issue of *Urban Land* holds that urban demands for land probably will not continue at present rates. He bases his conclusions on population distribution and projects a reduction in household formation between now and 1975. Bulges in demand will occur among newly established households and those of the elderly. Space requirements for these families will be smaller than for others. Apartment house and trailer living may be better adapted to their needs.

In addition, he continues, rural nonfarm density next to cities is growing and these areas are being incorporated or annexed. The decreasing number of middle-aged families may mean less pressure for rural living. The increasing productivity of new equipment is reducing space requirements per unit of goods and services turned out; redistribution of industry and commerce is bringing jobs and workers closer together; and a more efficient layout of the new urban streets and through ways is bringing

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<sup>&</sup>lt;sup>1</sup> Robinson Newcomb, "Are Urban Land Pressures Easing?" Urban Land, Vol. 17:5, May, 1958.

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more efficient use of land for transportation purposes. The increase in land use for urban purposes may be 20 to 30 per cent less between now and 1965 than it was during the 1940's, and the net additional use of land may decline somewhat below 1958 levels. This may make it easier to increase the proportions of urban lands used for parks and other recreational purposes, and it may encourage further renewal of the centers of the older cities. Several cities already are providing desirable living accommodations in large units through their redevelopment programs.

The rise in urban living, the shorter work week, and the fact that more people take regular summer vacations create new problems in rural land uses. On the one hand, it has reduced rural resident populations. On the other, it has provided new land uses and new occupational opportunities.

## Land Uses Projected to 2010

Estimates of land uses for the next 50 years vary greatly, depending upon the assumptions used—the technological progress within agriculture, the growth of urban populations and the level of nonfarm demands for land evolved. Apparently, there is ample land to meet foreseeable needs if we plan wisely.

Under assumptions currently in use, total acreage of cropland might be around 500 million acres by 1975. By 2010, it might rise to 575 million acres. Half or more of the increase would come from transfer of the best soils now in permanent grassland pasture to the cropping rotation. The assumptions also include replacement of some poor cropland by land improved through additional irrigation and drainage projects and by conservation and other programs.

Growth of the nonagricultural special use areas at rates comparable to the 1945-54 period would increase their importance from 100 million acres in 1954 to 180 million acres in 2010. Urban areas are projected to increase from about 19 million acres in 1954 to about 46 or 47 million acres in 2010; rural transportation facilities would increase from 24 million to 33 million acres; parks and wildlife refuges from 28 million to about 47 million acres; reservoir and flood control from 4 million to 15 million acres; national defense from 23 million to 29 million acres; and all other special nonfarm uses from about 1 million to more than 8 million acres. The necessary 80 million-acre adjustment would be about 75 to 80 per cent from woodland, pasture, and other land, and 20 to 25 per cent from cropland.

Review of the trends in special-use areas and population growth by regions indicates that the land required in these areas in the next 50 years might vary greatly, depending upon the assumptions used as to public policies, projected population numbers, employment, and income. With the accelerating rates of growth in the Northeastern, Lake Shore,

and Pacific states, it is possible that these regions will lead all others in acreages of land required for urban, transportation, and related purposes.

Along with growth in urban centers will come demands for increases in recreational areas, such as public parks and private vacation facilities. Because of the head start in park and wildlife areas set aside from the western public domain, the Mountain and Pacific regions may continue to rank high in terms of area and scenic values. In the Eastern, Lake, and Southern regions, additional recreational areas possibly can be set apart from national and state forests. Purchase of private land for necessary flood-control and water-supply purposes may add to recreational and wild-life areas. Private stream, lake, and seashore frontages will become more valuable. It would be farsighted for local and state governments to acquire first-class park and scenic lands in advance of the needs of the growing population and popular demand. Recent public surveys indicate that such investments are desirable but are lagging behind the need.

## Use of Water

A review of human history shows that property in water antedated property in land. The first right was for drinking, and the next was for irrigation. Later, if the supply was sufficient, public baths and fountains were allowed. Waterways provided the first easy way of traveling long distances, and aquatic life provided prehistoric man with food. The settlement of North America progressed first along the waterways, and modern industrialization had its start from waterpower and water transportation. Control of various riparian rights early spelled the difference between success and failure of industrial enterprises.

Localized problems of water control and management occurred all during colonial times. They grew and spread as population increased. Disasters such as floods were accepted as "Acts of God," or solutions were resolved by local customs that developed under the riparian doctrine of use.

The federal government reluctantly began to assume an important role in water programs in 1824 with an act to improve the navigation of the Ohio and Mississippi Rivers. One activity of the United States engineers during the mid-1800's, for example, was surveying and planning for navigation improvements and for such roads and canals as were of national importance. Serious floods on the Mississippi led to the creation of the Mississippi River Commission in 1879 to investigate navigation and related flood problems. It was not until 1928 that substantial amounts of federal funds were made available for construction of flood-control works. Up to that time, flood-control projects had been financed mainly from local and state sources.

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Some of the land grants made to states from 1849 to 1851 were made specifically to support drainage of wet lands. Other legislation in the 1870's initiated programs for buying or setting aside forest reserves for perpetuation of timber and for protection of watersheds. Still another regulatory function was applied in 1890 when Congress took jurisdiction over construction and maintenance of all obstructions upon the navigable streams. The Federal Power Commission was established to regulate power installations.

A number of federal and state agencies concerned with control and use of water development were formed during the early 1900's. Many of the economic and political theories of water management now in use had their origins during the heyday of the "Conservation Era." The Reclamation Act of 1902 and its amendments placed the Bureau of Reclamation of the Department of the Interior in the business of supplying water for irrigation and development of hydroelectric power. This legislation also established the principle that prior claim to the power developed at public projects should be held by states, municipalities, cooperatives, and other nonprofit institutions.

As the backlog of information about resource management and the demands for water use expanded, several new government agencies were organized. They were usually single-purpose oriented and subsequent legislation to expedite the principle of multipurpose development has been slow. Early federal emphasis was on transportation and trade. About 1900, emphasis changed to protecting resources, then turned to development. We are now entering an era of more effective integrated management. The trends appear to be toward greater cooperation among federal and local interests, multipurpose developments, and consideration of basinwide, regionwide problems and their solutions.

# Statistics of Water Supply and Use

The average annual precipitation in the United States is about 30 inches. About 22 inches, or 70 per cent, of it may return to the atmosphere directly through evaporation and transpiration. The rest is available to streams and underground supplies. The Geological Survey has estimated that present fresh water demand on surface and groundwater supplies is about 4 per cent of the total annual precipitation, or 13 per cent of residual precipitation. Of this supply, 83 per cent comes from surface waters and 17 per cent from ground water.

Unpublished data from the Department of Commerce shows that total water use in the United States has grown from 40 million gallons daily on the average in 1900 to 110 billion gallons in 1930, to 203 billion gallons in 1950, and to 262 billion gallons in 1955. The number of wells for all

purposes doubled between 1900 and 1955, and with the introduction of larger and more efficient pumps, the volume drawn per well increased many fold. In 1955, irrigation was the greatest user of well water with 46 per cent. It was followed by steam electric power and industrial and miscellaneous, each with 23 per cent, public water supply with 6 per cent, and domestic wells with 2 per cent of the total supply.

The Hoover commission estimated that during the 130 years from 1824 through fiscal 1954, the federal government appropriated about \$14.3 billion for water resource projects. From this expenditure, we have 237 improved harbors, 28,400 miles of inland waterways, more than 7 million acres of land irrigated by water from federal projects, and about 20 million kilowatt capacity of electrical power, either installed or under construction. Also, we have improved greatly our protection against floods. No estimate was made of the huge outlays made by districts and municipalities for similar purposes or of the funds and land grants provided for drainage projects.

The Geological Survey estimated total water drawn from the ground, lakes, and streams in 1950 to be about 180 billion gallons daily. Cities and rural communities withdrew 17 billion gallons (10 per cent); 83 billion gallons (46 per cent) were taken by industry; and 80 billion gallons (44 per cent) were used for irrigation. More than one-sixth of all water used came from groundwater sources. In addition to these consumptive uses, around 1,100 billion gallons daily pass through hydropower plants and are returned to streams.

Harry E. Jordan, of the American Water Works Association, reported in Water, The Yearbook of Agriculture 1955, that the average daily use of water from public waterworks in the United States in1900 was less than 95 gallons per person. Average use grew to 138 gallons per person in 1950 and 143 in 1955. It is estimated that the per capita use was distributed as follows: 50 gallons for residential uses, 50 for industrial uses, 10 for public uses, and 20 for commercial and industrial uses, with losses through leaks, breaks, and so on accounting for 10 gallons. Use of water in municipalities is largely nonconsumptive: more than 90 per cent returns to the watercourses below cities. If we add the citizen's per capita share of total national use, including industrial and agricultural use, we get a figure of 1,200 gallons per person daily.

# Projected Use of Water

In its report of December 1955, the President's Advisory committee on Water Resources Policy forecast that the total demand for water in the United States would almost double by 1975. New uses, such as air conditioning, will increase consumption of water in homes and commercial

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establishments to an estimated per capita consumption of 175 gallons per day from the public water supply. As new processes are developed, industry will also use more water. Lastly, supplemental irrigation use in the normally humid eastern part of the country now amounts to more than 3 million acres, a fivefold increase since 1940.

At the same time, with major population shifts from rural to urban areas, with extraordinary industrial growth (a 700 per cent increase since 1900), and with an increase in the volume, variety, and complexity of industrial wastes, the problem of water pollution and treatment have become increasingly complicated.

## Recreational Use of Water and Land

Time was when water and its associated physical resources, together with the scenery, the fresh air, and the zest they added to life were taken for granted. People lived closer to nature and absorbed benefits from that daily contact.

Times have changed but basically we humans have not. Medical men, psychologists, penologists, and others who try to keep the human animal within the bounds of accepted behavior limits emphasize that we are not equipped for a steady diet of urbanism and industrialization.

Recreation as far from the crowded hubbub as one can get is one of the medicines prescribed. It is composed of generous doses of rolling land, green grass, stately forests, sparkling water, wild birds and animals, peaceful solitude, and rest.

The greatest need for water for recreation lies within easy commuting distance of population centers. In a recent survey of the Delaware River Basin area, the National Park Service placed this commuting distance as about 60 miles, or two hours of driving time, for day outings and 120 miles, or three hours of driving time, for weekend outings. The same survey showed significantly that the four activities most desired while on vacations are swimmming, going to the beach, fishing, and boating—all directly related to water.

#### **Conclusions**

Our conclusions are obvious. We have used and still are using our land and water resources lavishly. It is clear that adjustments in types of use must come if our population and our industrial complex are to be supported satisfactorily.

Thus, over a long period, competition between agriculture and forestry, urban, industrial, and recreational development for the lands needed to supply the increasing demands for agricultural and forests products and for other goods and services may become keener. More group and individual consideration and action will be desirable to preserve the good

agricultural and forest land for production of needed commodities. At the same time, it will be necessary to provide and protect important recreational and scenic areas and to reserve suitable sites for residential use.

Important policy issues are involved in the growing needs for land and water, in the possible points of conflict, and in ways of meeting or avoiding them. First, there is need for private and public stocktaking of land and water resources and consideration of all reasonable requirements in planning specific uses of land and water, especially those that involve considerable shifts in use of valuable agricultural, forest, recreational, residential, and industrial areas.

Society's lag in dealing more effectively with land and water use, waste, and pollution has brought us to a point at which many areas of the United States—both East and West—suffer water shortages. Industry, irrigation, increased domestic consumption, and pollution, together with drought, produced the shortages. The adequacy and efficiency of our water use systems will be one of the ultimate limitations upon our capacity to increase production of farm and forest products and to grow industrially.

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#### RECREATIONAL USES OF RURAL LANDS AND WATER

C. W. LOOMER
University of Wisconsin

THE MAIN PURPOSE of this paper is to focus attention on the economic characteristics of recreational land use that distinguish it from other kinds of land use. These characteristics help define the role of recreation in resource policy and underlie most of the problems associated with recreational uses of land and water. The same characteristics also present unusual and difficult problems for economic analysis, both at the conceptual level and in the everyday quest for meaningful data and

practical methods of analysis.

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Recreation is a phase of human activity that is fundamentally difficult to define or measure. Inquiry into the ultimate objectives of leisure-time activity raises questions about what people really want out of life, as distinguished from what they do with the hours they devote to making a living. The output of recreation is not a tangible product that can be measured in bushels or board-feet, but instead reduces to satisfactions, well-being, and "re-creation" of body and spirit. The search for the basic values of recreation leads inevitably to a host of intangible social values and personal value judgments. Some of these are reflected—usually imperfectly—in ordinary market operations. Some become evident only at a higher level of social accounting, such as in public financing of governmental programs. Many are excluded, almost by definition, from any kind of rational economic appraisal.

Broadly speaking, the problems of recreational land use are essentially economic in that they involve the allocation of economic resources. However, the purely economic aspects are thoroughly intermingled with other considerations, possibly to a greater extent than in any other field of study in which economists are involved. In many situations, market values are peripheral, and judgments based on purely economic criteria are useful only insofar as they can be integrated into a broad behavioral analysis.

As if these complications were not enough, economic analysis of recreation is greatly handicapped both by the lack of data and by the fact that economists generally have devoted little attention to recreation as a land use. These limitations are not unrelated, since at least part of the present lack of economic data must be attributed to our inability to specify the kinds of information that are needed. The existing economic literature raises many provocative questions. Nevertheless, it is frankly exploratory

<sup>1</sup>See, for example, S. T. Dana, Problem Analysis: Research in Forest Recreation.

Washington: Forest Service, USDA, April 1957.

<sup>&</sup>lt;sup>1</sup>Marion Clawson, Statistics on Outdoor Recreation. Washington: Resources for the Future, Inc., 1958. See especially pp. 13-15.

and fragmentary, and there is yet no substantial body of sustained work to provide anything like a satisfactory economic method for this area of study.

In view of these difficulties, it may be well to consider the need forand the opportunities in—economic research dealing with recreational land use. First, there can be no question that recreational uses of land and water are rapidly becoming a dominant factor in resource use, particularly in rural areas. Some people believe that recreation is the one major rural land use that will almost certainly require expanded acreage as well as greatly increased inputs in the future.

Second, recreational land uses have developed so far without a great deal of conscious social planning and direction, but, as the pressure on resources continues to mount, there is increasing need for a rational appraisal of recreational requirements and programs. The role of economic analysis in this area can hardly fail to become more important, provided that its assumptions, methods, and viewpoints are consistent with social behavior.

Finally, it may be pointed out that difficulties of definition, economic measurement, and allocation of costs and benefits are typical of, but not unique to, recreational land uses. Similar questions also arise in connection with multiple-use water development, highway programs, urbanization of the countryside, revision of water statutes, rural zoning and police power regulations, and rural development programs. In many respects, problems of recreational land use typify a whole order of resource issues characteristic of modern economic life. The difficulties of economic analysis in recreation therefore represent a challenge to economists, since the adaptability of economic techniques here is a measure of the role of economics in the process by which society budgets its resources.

# Demand and Supply Characteristics

Expanding demand for recreational land, goods, and services is typical of modern life. Our growing population, rising income levels, increasing mobility, and the greater leisure coming from shorter work weeks and longer vacations are undoubtedly the major factors contributing to this demand. One is also tempted to discern what appears to be a change in consumer preferences—something on the order of a mass discovery of outdoor recreation as a desirable (and economically significant) aspect of living. All of these tendencies, however difficult to evaluate, operate in the same direction—that is, to increase the demand for recreational facilities.

Recreational activity has been increasing very rapidly in recent years, continuing a long-time upward trend broken only during World War II.

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This trend seems unlikely to be reversed by anything short of a major change in our way of life. On the other hand, the amount of land devoted primarily to recreation has increased much less rapidly, and in some areas not at all. Particularly since about 1940, the increase in recreational activity has been accommodated largely through intensified use of the areas already available.

The broad outlines of supply and demand in recreation are clear to the most casual observer. More and more people are crowding onto an already over-burdened recreational resource base, and there is little prospect for diminishing pressure in the foreseeable future.

It is characteristic of recreation, however, that there is little specific information about its needs and resources, particularly in the aggregate. So far, no great amount of public effort has been spent on research and data-collecting. As a consequence, it may not be far wrong to say that our present knowledge of recreation is as incomplete as our knowledge of agriculture would be if there were no USDA or state agricultural experiment stations. However, part of the uncertainty about supply and demand in recreation must be attributed to the nature of recreation as a land-using activity.

## Generalized Demand for Recreation

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The demand for recreational land derives from a wide range of landusing activities, including fishing, hunting, camping, boating, winter sports, and sight-seeing, as well as more passive forms of outdoor relaxation. The land resources used in these activities may be classified variously by uses, ownership, managerial objectives, and location. That is, recreational lands may be classified into public and private categories. The public lands may be further classified as those managed primarily for recreation (federal and state parks, for instance), or those on which recreation is a phase of multiple-use (national forests). Private lands may be classified as commercial (resort properties, for instance) and noncommercial (such as summer homes).

Although it is thus possible to distinguish between recreational uses and classify the land used for various recreational purposes, it does not seem possible to go far with a corresponding classification of demand. Characteristically, the demand for recreational outlets is generalized and includes many aspects of joint demand and substitutability. The element of substitution enters in whenever a family decides where and how it is going to spend its vacation. Joint demand is involved because one kind of recreational activity commonly seems to lead to others. The first tentative venture into family camping, for instance, seems typically to generate new interests in fishing, boating, and a wide range of related

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outdoor activities. The people who become accustomed to weekend trips to nearby state parks are probably all the more likely to undertake longer trips to federal parks in other regions, and perhaps to make greater use

of privately-owned facilities as well.

The typical recreation-seeker is footloose and increasingly mobile. Resort operators commonly observe that tourists nowadays move around more than they used to, visit more places, and stay a shorter time in each place. It is significant that in the past decade, during which the annual sales of outboard boats have more than doubled, the sales of boat trailers have increased by about 38 times. The recreationist is able to go great distances for some of his recreation, and in so doing he makes use of a variety of facilities during the season.

These characteristics have important implications for estimating the demand for individual types of recreational facilities. One suspects that the demand for national park facilities is not separately distinguishable from the demand for recreational opportunities in the national forests, and that both are largely the same as the demand for state and local park facilities. In the last analysis, many and perhaps most of the components of demand tend to merge in a collective, unspecialized demand for a variety of recreational outlets, some private, some public, some distant, some close at hand.

## Non-Economic Characteristics of Demand

From the economist's viewpoint, the most notable characteristic of demand for recreation is that much of it seems to have no economic dimensions at all. A large part of the goods and services of outdoor recreation are not priced on the market. Recreational users, of course, face up to economic realities when they rent a summer cottage or buy a lake-shore lot. For these aspects of recreation, demand may be expressed as a function of market price. But in many instances, users seem to "demand" goods and services without any expectation or intention of paying for them.

It is oversimplification to conclude that the recreationist makes free use of public land but has to pay for the use of private land. In recreational uses, property lines are blurred. Private land entered under the Wisconsin forest crop law is open to public hunting and fishing as a condition of the contract with the state. Privately-owned industrial forests are generally open to public use. Hunters and fishermen commonly enter any land not protected by "no trespassing" signs, and sometimes even when the signs are present. Both on public and on private lands, then, much of the demand for recreation is non-economic in the sense that users do not pay directly for the use of the land.

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nen, hat There are several consequences, one of which may be a persistent tendency to underrate the forces of demand. One has the impression that economical-rational observers are more often than not surprised at the effectiveness of demand, in the operational sense, demonstrated by fishermen's organizations when arrayed against such economic users as farmer-irrigators. It is probable also that the free-use traditions of recreation stand in the way of serious efforts to determine what the traffic will bear.

Perhaps most important for economic analysis, however, is the obvious need for a frame of reference broad enough to encompass all elements of price. The free use of public recreational facilities is free only within the traditionally restricted definition of the market. Actually, recreational users pay in the form of hunting and fishing licenses, park-use permits, camping fees, and other direct charges. They pay more, indirectly, in the form of tax supports for the land, improvements, and services provided by government. Furthermore, one has only to estimate the investment in privately-owned camping equipment, boats, trailers, and automobiles seen in public campgrounds to appreciate that users pay for many of the capital inputs needed to produce benefits from recreational land uses.

These are considerations that add economic substance to the demand for recreation. This is not to imply that all the costs and benefits in recreation can be identified, measured, and allocated in economic terms if only the analyst looks long enough in the right places. It should suggest, however, that the true economic dimensions of demand for recreation can be seen better from a viewpoint that includes at least those aspects of marketing expressed in taxation, governmental budgets, and public services.

# Supply in Relation to Physical Types of Land

Recreational land cannot be clearly identified by physical characteristics alone. Viewing outdoor recreation in the various forms it takes in different seasons and throughout the country, one may conclude that nearly all kinds of land have at least potential value in recreation. For specific uses, there are meaningful classifications by physical types.<sup>3</sup> In general, however, recreational lands are distinguished primarily by their use rather than by inherent physical qualities. This is a fact that is particularly significant in appraising the potential supply of recreational lands. Some areas, obviously, are distinguished by scenery or natural phenomena that give them special value in recreation and perhaps also make them less adaptable to other uses. However, most of the land with these unique qualifications—typified by the areas judged suitable for

<sup>&</sup>lt;sup>3</sup> For example, see C. R. Humphreys, et al, Shoreline Classification of Berrien County, Michigan, East Lansing: Michigan State University, 1958.

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national park status—have already gone into recreational uses. It seems inevitable that future additions to the supply of recreational land must come from less distinctive physical types for which other land uses are more strongly competitive.

## Multiple Uses of Recreational Lands

Another—and perhaps the most important—characteristic of supply is the fact that most of the land used for recreation is also used for other purposes. On the public lands, recreation is usually carried on as a phase of multiple-use. Various estimates suggest that only a fifth or a sixth of the federal and state land used or available for recreation can be classed as primarily or exclusively devoted to recreational uses. For the remainder, constituting the bulk of public lands, recreation is a joint use carried on more or less simultaneously with other uses such as forestry, watershed protection, and grazing. It is largely because of this multiple-use characteristic that we have no meaningful estimates of the total area of land now used for recreational activities.

Recreational uses of privately-owned land do not involve multiple use, at least not in the same way that the term applies to public lands. In another sense, however, a summer home represents a form of joint use, since it is both a recreational use and a residential use. The difficulty of making a categorical distinction between summer homes and other rural nonfarm residences illustrates the difficulty of setting precise limits for the term "recreation."<sup>5</sup>

It is one of the virtues of recreation as a land use that it does not demand exclusive possession of the land it uses. Recreation is almost ideally suited to the multiple-use concept of resource management. Within limits, it is possible to hunt in the grain fields, camp in the forests, and fish in the streams without interfering unduly with other uses to which those resources might be put. It would seem that wider application of the multiple-use principle holds real promise as a means of expanding recreational outlets without altogether displacing other land uses.

At the same time, this characteristic of recreation brings into sharp focus a basic difference between public and private ownership as alternative means of providing recreational opportunities. Under public land management, it is possible to accommodate joint uses that have quite different economic characteristics—for instance, forestry as a goods-

<sup>&</sup>lt;sup>4</sup>H. H. Wooten, Major Uses of Land in the United States, USDA, 1953, p. 53; Clawson, op. cit., p. 3.

Clawson, op. cit., p. 3.

<sup>5</sup> In a recent Wisconsin study, recreational sites were defined as those "... within 100 yards of the Wolf River or a lake."

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producing economic enterprise, and recreation as a non-economic service for an unidentified segment of the general public. There is serious question whether multiple-use is a workable concept of management under private land ownership with its emphasis on exclusive possession and management of resources in the personal interests of the landowner.

## Conflicts and Problems

It is one of the paradoxes of recreation that as increasing numbers of people grow to appreciate nature and seek enjoyment in the outdoors, they tend to destroy the values they came to find. Recreational uses of land are essentially extensive uses. For many people, the ideal man-land ratio in outdoor recreation is represented by the wilderness areas. Yet, an increasing intensity of recreational land uses is unavoidable if recreational opportunities are to be made available to a growing population of users.

At the worst, greatly intensified use of recreational facilities may reduce the aggregate social benefits by subdividing them entirely away among a multitude of users. At the best, intensified use must inevitably bring about a qualitative change in recreational services. Old-timers frequently deplore "put-and-take" trout fishing and the overly-civilized trappings of fully-developed camp-grounds. The inescapable fact is that there are not enough natural trout waters and native trout to support present fishing pressures. In a 50-unit campground, hot-and-cold running water, flush toilets, and printed lists of camp regulations are not so much matters of preference as of necessity.

The increasing pressure on resources, however, is revealed more in conflicts between different recreational uses than in conflicts between recreation and agriculture, forestry, and industry. With the exception of disputes over water, our studies in Wisconsin have revealed no significant land use competition between agriculture and recreation, and, in fact, little direct economic relationship between the two industries. We have found no instances where land with appreciable recreational value is being used for farming. As far as we know, local markets for farm commodities are not noticeably affected by the recreational trade, and there do not seem to be many farm people who find part-time or seasonal employment in recreation.

The relations between recreation and forestry are more direct, but are generally complementary rather than competitive. Recreation and timber production are joint products of the forest environment. Most foresters seem prompt to recognize the recreational values of forests, and most forest land is open to recreational uses in one form or another. In general, forestry programs are considered beneficial to recreational interests,

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if only because they help to create the kind of physical environment in which recreation flourishes.  $^{\rm 6}$ 

Within recreation, however, there is great variety of competition and conflict between users and uses. These problems, in varying degrees, involve conflicts of interest between different levels of government, between local residents and users from other areas, between property owners and users who are not on the tax roll, between commercial and non-commercial interests, and between public and private viewpoints. A few illustrations may suggest the scope and variety of these problems.

In the lake country, sites with the physical characteristics suited for resort development are usually sites that are also suited for organization camps, private summer homes, and public campgrounds. Summer home residents, for the most part, dislike the traffic and commotion associated with the tourist trade. Resort operators sometimes complain that their guests are disturbed by the early-morning bugle calls and youthful noises coming from nearby summer camps. Property owners generally seem mildly hostile to public campgrounds, possibly because these are not taxpaying ownerships and possibly because family campers seem to represent a diversion of potential trade for commercial recreation. Campers themselves frequently resent the fact that prime recreational lands are tied up by private ownership and inaccessible to the general public.

Many of the conflicts in recreation arise not over land uses but over water. While these problems are most characteristic of the lake country, it seems probable that they may become commonplace as a result of widespread development of recreational uses in reservoir projects. In Wisconsin, the liveliest current issues in outdoor recreation concern lake access and boat licensing. The lakes of the state are public waters, yet on some 1700 lakes the shoreline is entirely in private ownership and the public is effectively denied use of the water. The public clamor for opening the private lakes comes from the growing popularity of water sports and the increasing number of water users who range over wide areas in search of recreational outlets. The opposition comes primarily from local property owners who point out, with some justification, that heavy use, particularly of smaller lakes, tends to destroy the values for which lake properties have been bought and developed, and on which property taxes are based.

A state agency was recently authorized to acquire land for lake access, but county boards have had this power for more than 20 years. Their

<sup>&</sup>lt;sup>6</sup> Perhaps this happy relationship ought to receive more consideration in economic studies of forestry per se. In areas where there are few opportunities for forest recreation, much of the forest land is in small private holdings and farm woodlots. Yet it is in these aspects of forestry that economists seem particularly intent on appraising forestry solely in terms of the market value of the timber produced.

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notable reluctance to act probably reflects the basic conflict of interests between local people and outsiders. Local interests have recently become involved in a different way. A sportsman's association acquired lake property near Milwaukee for use as a parking lot and boat launching site for its members and the general public. During the past month, a court has held that this use violates a local zoning ordinance that restricts the lake shore to residential uses. The lake access issue thus involves the well-established right of local units to adopt and enforce land use regulations.

Lake access is closely related to the issues involved in boat licensing and regulation. A growing number of municipalities in Wisconsin are now imposing annual license fees ranging up to \$20 as a charge for the use of waters within their jurisdictions. The state has recently instituted proceedings to test these local ordinances on the grounds that they limit the free navigability of public waters guaranteed by the constitution. On the other hand, licensing and regulation go hand in hand, and the policing of the lakes is apparently considered to be a local responsibility. There is no doubt about the increasing need for regulation and policing of lake uses. Interviews with lake-shore residents and resort operators indicate that the most commonly-recognized "land" use problem is the threat to fishing, swimming, and shore installations posed by fast, highpowered boats. A growing number of rural towns are adopting ordinances prohibiting the use of large outboard motors on certain lakes or restricting them to midday hours. It was recently reported that a local court has now held such a regulation to be an unreasonable restriction on the rights of water skiers and other lake users. At this stage, it seems inevitable that legislation action will be necessary before these conflicts can be resolved.

Another kind of land use problems results from haphazard and uncontrolled recreational development. With the possible exception of residential uses, there is no other kind of land use in which preservation of the landscape is more vital. Yet it is painfully apparent that some of our most attractive natural resources are being destroyed by crowded and unplanned development. Worse, some recreational areas are becoming rural slums that are actually unsafe as well as unsightly and unpleasant places to live. Furthermore, the common pattern of development too often limits recreational uses to a narrow strip of riparian sites, cutting off the land lying back from the water and leaving no room for expansion of recreational uses after the lake shore has been taken up.

These problems are in large part the product of faulty layout design. They can be avoided by providing lots sufficiently large to accommodate sewage absorption systems and protect water supplies. Set-back lines might be used to keep buildings from clustering on the water's edge where they crowd together and destroy the natural beauty of the shore line. By

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reserving part of the shore for public use and providing access lanes at intervals, recreational values would attach to nonriparian lands that are otherwise almost useless for recreation.

In cities, it has been found that the prevention and cure of undesirable land uses require aggresive public action, typified by subdivision control, use regulations, and, sometimes, slum clearance and redevelopment. In rural recreational areas, the density of use is beginning to approximate urban conditions, and similar remedies may be equally appropriate. So far, with minor exceptions, private recreational development is largely unplanned and uncontrolled, at least from the public viewpoint. It must be admitted that the resulting land use problems have not yet created any noticeable agitation or demand for action, but it seems likely that the time is not far off when these emerging difficulties will be recognized.

## Research Proposals

As a field for economic research, recreation is virgin territory. Almost any line of research is still exploratory; almost any new project proposal offers the promise not only of yielding new and needed information but also of opening up avenues for further study. The following suggestions are offered, therefore, merely to illustrate rather than to exhaust the numerous possibilities for additional research in recreation.

The literature gives strong evidence of basic needs for (1) more and better statistical data suited to economic analysis, and (2) methods of economic analysis better suited for appraising recreational needs and resources.<sup>7</sup> There is particular need for data and methods adapted to measurement of recreational factors at the regional and national levels. One area for study, therefore, is the research needed to develop aggregative measures of recreational demand and supply, intensity of use, inputs and output—all in terms permitting valid comparisons between recreation and alternative uses of resources.

Another area of needed research might be described as studies of the scope and characteristics of the commercial recreational industry. The commercial recreation industry ranks third in importance in a number of states, and is of first importance in many localities, yet there are practically no comprehensive data on the number and kinds of development, size of operations, numbers employed, wages, income, property values, and taxes paid. It might be pointed out that commercial recreation is the phase of recreational activity that most nearly conforms to the theoretical model for economic enterprise. Research in this area would therefore be concerned more with data-collection and analysis than with the development of new methods and measures.

<sup>&</sup>lt;sup>7</sup> Suggestions for research in these areas are given by Dana and Clawson in the publications cited.

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Another promising area for additional research might be a study or a series of case studies to measure the economic impact of recreational development, perhaps regionally, but certainly at the local level. At present, we simply do not know what recreational development means to the community. Such an analysis would involve studying resorts, boat liveries, and similar recreational businesses, and also such Main-Street enterprises as drug stores and filling stations that draw only part of their trade from recreation. Consideration would also be given to summer home residents and their place in the local economy, and some way would have to be found to measure the economic effects of public recreational development, such as parks and campgrounds. Measurement of economic relationships would require consideration of trade, employment, and taxes, and possibly also the kinds and costs of governmental services that can be linked with recreational development. Obviously, such a study, even at a local level, might easily become quite involved, yet a thoroughgoing appraisal of these complex relationships would help to give substance to the littleknown role of recreation as a factor in area development.

Some of the most challenging research opportunities in recreation involve the economist in his capacity as a political economist or team-member working to devise public and private measures for improving land uses. For instance, some kinds of recreation are obviously best provided through public land ownership, and there seems little doubt that this area of public action must expand in the future. There is great need, however, for studies that will help to answer the specific questions of what, where, and how much public ownership will be needed in the years to come, giving due consideration to the roles of government and private enterprise. The urgency for considered judgments on these matters lies not only in the pressure of immediate needs but also in the necessity for taking prompt action if future needs are to be met with a minimum of cost and disturbance. Important areas of recreational lands are now being created in reservoir projects, for instance. The dedication of such lands to public and private uses should be based on a thoughtful appraisal of future requirements and opportunities.

The possibilities of using economic incentives to expand public recreational uses of privately-owned land are worthy of serious study. At present, the private owner has more to lose than gain by allowing the public to hunt, fish, picnic, and camp on his lands, yet a relatively modest payment or tax concession might make the difference. Considering the great social interest in recreation, it would seem entirely appropriate to undertake a fairly elaborate program of incentive payments to landowners. These might compensate the owner not only for opening his land to public use but also for carrying out "approved recreational practices," such

as stream-bank improvements, providing wildlife habitat, and perhaps constructing picnic tables and camping facilities.

Through inducements of this sort, it might be possible to promote public recreation as a secondary use of privately-owned lands in somewhat the same fashion that recreation is provided under multiple-use management of public lands. The usefulness of such a program would be especially great in areas where there are now only limited public land opportunities.

A much greater degree of public regulation of private recreational uses of land and water seems inevitable. Research that contributes to the better design of police-power measures deserves high priority. It is possible, however, that the land-use problems that might be attacked through zoning, subdivision controls, and public health regulation might also be handled by public leadership in fact-finding and education. It is suggested, therefore, that studies might well be directed at finding ways to help private owners make better use of their resources, in their own as well as the public interest.

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For instance, there is no doubt that many private recreational developments are poorly designed, and that initial mistakes in planning adversely affect subsequent uses and values. It is equally apparent that public agencies do little to help the private subdividers and surveyors who make the crucial on-the-ground decisions when land is platted. One type of needed study, therefore, might undertake to develop standards of good recreational design and make them available in handbooks for recreational land planning. While the Forest Service and doubtless other agencies as well have already worked out land use and architectural designs suited for summer home and resort development, this kind of information is not now generally available.

Another phase of study would aim at developing methods for getting good standards adopted. Here the experiences of city planning should provide valuable insight. It might be, for instance, that a public recreational planning agency should be created to provide technical assistance for private developments. The agency would help private subdividers not only as a technical consultant but also by assuring that the plats meet the standards required for approval. At the same time, the agency would safeguard public interests by seeing that proposed subdivisions include adequate dedication of land for public uses as well as meeting the requirements for sanitation, drainage, and fire protection. The agency might perform a still more important function by providing an organization for coordinating subdivision regulation with zoning, building codes, board of health regulations, and other directional measures.

## MINIMIZING ADVERSE EFFECTS OF MAJOR SHIFTS IN LAND USE\*

RALEIGH BARLOWE
Michigan State University

SHIFTS in land use are not a new thing in our society. The shifting of land areas from one use to another is a perfectly natural phenomenon in a dynamic economy—particularly so in an economy characterized by a growing population, expanding demands for land products, high per capita incomes, and considerable free agency in operator decisions re-

garding the ownership and use of land resources.

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But while the shifting of land use that has taken place in recent years is by no means unusual or unexpected, it does appear that we are more conscious now than ever before of the adverse effects often associated with these shifts. This concern stems from a number of factors. We have taken up practically all of our promising agricultural land; increasing numbers of new persons are being born who must be fed and clothed in the years ahead; and we are permitting the diversion of thousands of acres of productive farm land to nonfood-producing uses. Our concern in this area has also been sparked by a growing social consciousness of a need for measures that will promote the orderly development of our land resource base and at the same time minimize potential conflicts over land use.

This paper is concerned primarily with means for minimizing the adverse effects associated with major shifts in land use. From an organization standpoint, it is divided into four parts. Brief consideration is first given to the concept of succession in land use. Attention is then focused on what we mean when we speak of "adverse effects of shifting." An attempt is made in the third section to itemize the principal means we have for minimizing these adverse effects. And final emphasis is given to the development of effective programs for this purpose.

## Succession in Land Use

It is a well-recognized fact that land resources tend to move to those owners who bid the most for their control and to those uses that offer the highest return for their utilization. This succession process is sometimes stalled by institutional barriers, personal inertia, or the contrary goals of individual property owners. In general, however, whenever a site ripens for some higher economic use and effective demand favors its use for this purpose, the area in question tends to shift to its new highest and best use.

The rate at which land uses succeed each other is normally governed by

<sup>&</sup>lt;sup>6</sup> Journal article 2304 of the Michigan Agricultural Experiment Station.

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the bidding and counterbidding that goes on in the marketplace. Land ripens to higher uses when operators see an opportunity to use them for more remunerative purposes and show both willingness and ability to bid their market values up to the levels at which shifts in ownership and use take place.

Evidences of succession in land use are found all about us. The sites of most of our cities were covered with forests or prairie grass a scant two centuries ago. With the arrival of the white man, they ripened into farm sites and later into the changing residential, commercial and industrial

sites of our present cities.

This same succession process is still at work. Thousands of acres of farm land—including some of our most productive farming areas, in some instances—are moving into rural residences, under-utilized part-time farms, golf courses, new subdivisions, suburban shopping centers and industrial sites, highway rights-of-way, reservoir flowage areas, and other nonfarm uses. At the same time, substantial acreages of forest, range, and desert land are shifting into cropland use. With each of these examples, land shifts because the owner or some other operator sees an opportunity to put it to a more productive or more remunerative use. It shifts because the owner is offered a price or envisages a rate of return or a level of satisfaction somewhat in excess of that warranted by its present use.

Most of our succession in land use is price oriented and reflects the operations of the market. But other factors also influence the succession process. Operator decisions are often affected by nonmonetary considerations of a personal or private nature. They are frequently governed by public policies and programs that substitute social priorities for private

priorities in land resource development.

Group action involving exercise of the power of the state provides the most potent means society can use to attain its over-all objectives in land resource use. The need for this type of action is most keenly felt in those areas where the maximization of a private operator's interests has adverse effects on the interests of his neighbors, his community, of the nation-at-large. Some public or social direction of the land use succession process is frequently needed on these occasions to protect the economic and extramarket interests of average citizens and to maximize the total social returns from our use of land resources.

# Adverse Effects of Shifting

Most succession in land use may be characterized as desirable. Some undesirable effects, however, are associated with almost every type of land resource development. The extent of these adverse effects naturally varies a great deal with different projects.

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The question of what constitutes an undesirable or adverse effect needs clarification. Adverse effects are hard to identify because what appears desirable to one person or one group may seem quite undesirable to others. A subdivider may feel that he is doing society a good turn when he buys a 100-acre truck farm and converts it into an attractive subdivision with 300 building lots. Others may regard this same development as undesirable because it takes fertile farm land out of agricultural use. A property owner interested in the future use of his entire property may dispute the desirability of a highway project which requires part of his land and which may split his property into two or more segments. The Army Corps of Engineers may argue with the support of downstream residents that it is essential that the bottomlands of a certain valley be used as the flowage area of a proposed flood control project. The farmers to be displaced by the project and numerous citizens-at-large, on the other hand, may regard the project as a wasteful use of productive farm land or as just another example of government boondoggling.

In still other examples, a group of sportsmen may oppose the location of an industrial plant along a stream because of the adverse effects the industry's waste disposal program may have on fish life in the stream. Conservation groups may oppose the construction of a large multipurpose dam because it will flood the fossilized footprints of some long-forgotten dinosaur. An urban home owner may deplore the redevelopment of a neighboring lot as a site for a gas station because it reduces the value of his property for residential purposes or because it foreshadows the future shifts of his own property to some commercial use; or a householder may disapprove the building of a house on a vacant lot that his children have used for a playground.

As these examples suggest, the question of what is and what is not an adverse effect really depends upon one's point of view. Almost every project involves adverse effects of some type for someone. These adverse effects are apt to occur just as much in projects engineered by public actions as in those prompted by private marketplace calculations. Some adverse effects are minor and purely personal in nature, while others have broad social implications. Some involve capital outlay, time, and supersessions costs while others may involve considerable social and economic waste.

From a practical standpoint, it should be obvious that we cannot hope to eliminate or minimize all the effects individuals may regard as adverse. Our concern here is mostly with the effect that shifts in land use have upon social welfare. It is recognized that individuals often object to public programs on the ground that they narrow their personal opportunities to exploit the interests of others or that they deprive them of opportunities

to maximize their personal interests. We are not concerned with these objections.

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Our concern over the adverse effects of major shifts in land use has no rigid boundaries. In general, however, we are concerned mostly with those effects that give individuals a reasonable legal claim for just compensation for the loss of property rights. And we are also concerned with the effects of any development that leads to a significant shifting of costs to other groups or to society at large.

## Means for Minimizing Adverse Effects

Two major types of social action may be used to minimize these adverse effects. The first of these involves a variety of informal controls such as our use of custom, group mores, education, and public opinion to secure particular land use objectives. The second involves the more formal exercise of the public police, taxation, eminent domain, spending, and proprietary powers.

Human behavior is always conditioned by the culture and environment in which it takes place. Man is born into the stream of society. From the moment of his birth he shares in a social heritage—a system of rules, institutions, and social organization—that tends to condition and control his attitudes and reactions throughout his lifetime. Each of us is motivated and often checked in our land use decisions by what has been accepted as reasonable behavior in the past and by what we think will be considered acceptable in the future. Custom and tradition have played important roles in shaping individual land use decisions in the past. In some areas they have contributed to a reluctance of operators to shift to new uses or to improved ways of doing things. Along the frontier, they have often favored the widescale acceptance of exploitive practices in resource use.

Educational programs that lead to new attitudes of mind, such as a readiness to accept new technological developments or a willingness to carry on resource conservation practices, provide an extremely important means for minimizing some of our long-run problems in land use. Information programs that help shape public opinion also play important roles in this respect.

Informal measures of this order should be used in most if not all programs for the social direction of land use. They are important because the success of these programs usually calls for popular understanding and appreciation of the need for measures to promote orderly land use and to minimize economic waste. Education and an enlightened public opinion are also needed to induce private property owners to voluntarily direct their activities in directions that will optimize social welfare.

Directional measures of a more formal and more forceful type are frequently needed to insure the attainment of social objectives. Thus our

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governments often find it desirable to exercise their police, taxation, eminent domain, spending, and proprietary powers either separately or in various combinations as a means of securing particular land use goals. A few comments are in order concerning the nature of each of these powers.

The police power involves the sovereign power of governments to act for the protection and furtherance of the health, safety, and welfare of their citizens. Its history throughout the past century has been that of an evolving, expanding power that can be adapted to the needs of emerging situations. The exercise of this power is limited by the judicial concept of reasonableness and by the constitutional requirements that no person be deprived of life, liberty or property without due process of law and that all persons enjoy equal protection of the laws.

Even with these checks, the police power has evolved as an increasingly important means for regulating land use. It has long been used as a basis for providing police and fire protection for individuals and their properties. It is used to control contract rental rates, to prescribe building codes, to authorize the use of zoning ordinances and subdivision restrictions, to permit the use of soil conservation and weed control regulations, to control air and water pollution, to establish forest cutting regulations, to set up marketing quotas and crop acreage controls, and for many other similar uses.

The power of taxation represents a time-honored power which all governments use to collect revenues and which some use from time to time as a means for directing land use. Chief Justice Marshall once described the power to tax as "the power to destroy." But our courts have also characterized it as "the power to keep alive."

Our use of the taxing power as a directional measure is hampered somewhat by (1) the judicial rules that taxes must be levied for public purposes and that they be levied in an equitable and reasonable manner, and (2) the "uniformity" and "equality" clauses included in several state constitutions. Even with these limitations, however, it should be noted that taxation policies can be used to promote particular conservation practices as when special forest crop taxation measures are used to encourage private long-term forestry. Taxes can be used to favor particular tenure groups or to foster the breaking up of the estates held by certain groups. They can be used to encourage the shifting of land resources to more intensive and more productive uses. Furthermore, their impact on the cost structure of various enterprises may either favor or discourage the shifting of enterprises to new locations and the shifting of land areas to new uses.

Eminent domain involves "the power of the sovereign to take property

<sup>2</sup> Nicol v. Ames, 173 U.S. 509 (1899).

<sup>&</sup>lt;sup>1</sup>McCulloch v. Maryland, 4 Wheaton 316 (1819).

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for public use without the owner's consent." This power has its origins in the age-old power of governments and rulers to take private property for their own use. As accepted in the United States and Canada, however, this power is subject to three important restrictions: (1) the taking power is vested in our federal and state or provincial legislatures but can be delegated to government agencies and to public and private corporations, (2) it can be used only for public purposes, and (3) any taking of property must be accompanied by the payment of just compensation.

Use of the eminent domain power to minimize adverse effect of major shifts in land use has been limited. Its use to make private lands available for public developments often makes it a leading factor in the shifting process. In this sense, improvements in the condemnation procedures used in the United States and in the expropriation procedures accepted in Canda may well be needed if we are to minimize some adverse effects of shifting. A major use could be made of this power through its joint use with the spending and proprietary powers to transfer the development rights of certain open space areas to public ownership for future administration in the public interest.

The spending power represents another important power governments can use to direct private and public resource use. This power does not involve a formal control over property rights in land. But it deserves mention along with the police, taxation, and eminent domain powers because of the dominant role it has come to play in public resource development policy.

Public funds are frequently used in the public acquisition of private properties for forest, recreational, military, and other purposes. Public funds have been widely used in recent decades to promote a variety of reclamation, flood control, navigation improvement, power, and other public works programs. They have also been used to finance public credit programs and to subsidize the acceptance of conservation practices on private lands. A major use of the spending power to promote resource developments and to alleviate many of the problems caused by new developments has come with our use of public grants-in-aid. This cost-sharing approach is now being used to a considerable extent with our expanded highway construction and small watershed programs and with our public housing, urban renewal, and metropolitan planning programs.

The proprietary or public ownership power represents a fifth important power that society can use in its direction of land use. Governments have long since found that they can exercise far more control over the uses made of land resources when they own these resources or certain strategic rights

<sup>&</sup>lt;sup>3</sup> Julius L. Sackman and Russell D. Van Brunt, Nichols: The Law of Eminent Domain, vol. 1, p. 2. New York: Matthew Bender, 1950 (3rd edition).

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in them than when these resources are held in private ownership. We have recognized this principle in our acquisition of sites for public buildings, parks, forest and military areas and in our acquisition of either the land or rights-of-way for public roads. The proprietary power is also used in our urban redevelopment programs to acquire and clear sites which can then be leased or sold with deed restrictions to private developers.

Our past use of the public ownership power has probably helped minimize some adverse effects that might otherwise have come with shifts in land use. But it has also prompted shifts which have had adverse effects on some groups. On the whole, we have made only limited use of this power as a means of minimizing adverse effects. Several European cities have gone far beyond us in this respect in their acquisition of extensive areas in their environs which they can then develop according to plan as the need arises. The British Town and Country Planning act of 1947 accomplished much the same result when it took action which essentially amounted to a nationalization of the future development rights of the land in and around cities. There has been little sentiment as yet for either of these courses of action on this side of the Atlantic. As time goes on, however, we may well witness a considerable use of the proprietary power as a means of directing the future use of our land resources.

## Development of Effective Programs

Much can be said about the many different ways in which these formal and informal controls can be used to help minimize the undesired effects of changes in land use. Police power measures calling for minimum performance standards could be used to minimize the adverse after-effects of strip mining operations. Performance standards of a comparable nature are used in the forest cutting laws of several states. Similar approaches have been used to set up open country zoning ordinances that earmark certain areas for permanent forest or recreational uses, to limit the number of cattle that can graze the open range, or to prescribe "sod land" or "blow land" ordinances for use in soil conservation districts.

Special tax programs could be developed to discourage undesired shifts in land use. Action could be taken to reappraise our prevailing concepts as to what constitutes "fair compensation" for property taken by eminent domain and to provide for more emphasis on the economic justification of those projects that involve the taking of private lands for public use.

<sup>&#</sup>x27;This act vested the development rights in land in the government. Arrangements were made for sale of the privilege of developing particular sites at a price equal to the difference between the current value of the site and its expected value in its new use. This arrangement was eliminated in the Town and Country Planning acts of 1952 and 1954. Cf. Peter Self, Cities in Flood, London: Faber and Faber, Ltd., 1957, pp. 150-159.

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Emphasis should also be given to setting up comprehensive resource planning programs that can guide our choices in the location of new highways, reservoirs, military installations, and other similar developments.

One of our major problem areas in the development of effective programs for minimizing the adverse effects of shifts in land use concerns the problem of rural-urban shifts. Considerable attention has been focused in recent years on the extensive areas that have shifted from rural to urban and suburban uses. Precise data are not available concerning the exact extent of this shift, but it is estimated that upwards of a half million acres a year have moved into urban and suburban uses since the end of World War II. This constitutes a major shift in land use—and all the more so when one remembers that much of the affected area has high value for agricultural as well as nonfarm uses.

In many respects, it is regrettable that some of this land has not been retained in agricultural and other open space uses. It is also understandable that many people have been carried away with arguments concerning the dire effects of this diminution of our supply of cropland. On the whole, however, there has been too much exaggeration of the evils of shifting, and particularly of the effects of this shifting process on future food supplies. Agricultural surpluses are an old problem in the United States and Canada and, barring some catastrophe, will probably continue as a problem for many decades to come. A shortage of land for food production purposes may become a problem in the centuries ahead but this problem is not likely to raise its ugly head during the next few decades.

Our capacity to produce food is so great relative to the small proportion of our total land area used for residential and urban uses that we could easily double or treble our urban areas without complicating our over-all food supply problem. Furthermore, most of the rural areas shifting into subdivisions and other urbanized uses are shifting to higher valued uses and to uses capable of producing more in the way of satisfactions and social utilities than they could produce in agriculture. Also, if the need should arise, much of the land now planted to grass in residential subdivisions could be converted to intensively cultivated gardens which would probably produce more food than if they remained in farms.

A realistic appraisal of the situation as we now understand it indicates that the Neo-Malthusian worry about land shifting into home sites cannot be defended on either economic or social grounds. Our concern with this problem should be more that of securing orderly land use and of minimizing waste, than that of saving land for permanent agricultural use. This does not mean that efforts should not be made to save good farm land for future agricultural use. Some saving of this type is desirable around many of our cities in the interests of good resource management.

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ble nt. Attempts should be made to preserve greenbelts and open space areas amid the outward sprawl of our cities. Good reasons may be advanced for saving prime agricultural areas in California, in the irrigated areas of the West, and in some eastern communities where the suburbanization movement can be directed to alternative sites that have low values for nonurban use. But even in these instances, it is hard to justify the saving process on a "threat of famine" basis.

The major land use problem around our cities now is that of promoting an orderly and efficient pattern of development. Present trends indicate a continued increase in population in the United States and Canada, more than three-fourths of which will probably end up in our metropolitan communities. Our large cities will experience considerable population growth within their corporate boundaries, but a major portion of this expected growth will probably be housed in the suburban communities that ring our metropolitan centers.

This suburbanization movement will favor the continued outward sprawl of our cities and the continued shifting of rural areas to urban uses. Transportation improvements—primarily the building of controlled access highways—and the decentralization of some industries will favor the outward movement of many urbanites from our central cities. At the same time, however, time and distance considerations together with our urban redevelopment and neighborhood conservation programs will play substantial roles in favoring a more effective and often more intensive use of the land areas currently found within cities.

More public planning is definitely needed if we are to secure orderly and effective land use around our cities. Without public planning and the development of measures to enforce compliance with a master plan, we can expect little more than the usual haphazard pattern of development. Some private developers do exceptional jobs in laying out subdivisions and constructing buildings that make optimum use of their sites. But others plat their highway frontage-often with long, narrow "riflerange" lots-or lay out subdivisions with poor street design and with little, if any, provision for the public water, sewerage disposal, and other services the area will need as it takes its place as a part of the larger community. Areas which should be reserved for industrial or commercial sites, new streets, school grounds, or parks and recreational areas are frequently built upon with the result that costly redevelopment programs must be undertaken at later dates. And other areas which could support high standards of development are sometimes covered with low quality structures that blight the area from the start and foreshadow the rise of suburban slums.

A major problem in the development of effective master plans around

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our cities stems from defects in our system of government organization. Only two of our cities, Toronto and Miami, have metropolitan forms of government that gear the interests of the whole metropolitan community into one organizational structure. Some other cities boast metropolitan planning commissions, but these commissions usually operate on an advisory basis without any assurance that their plans will be accepted by all the local units of government involved. Annexation to the central city is often suggested as an answer to this problem. But local loyalties and sentiments frequently make this approach politically impracticable. Greater use of the metropolitan government approach seems to offer one of the best ways of coordinating the land use planning process around our cities. In so doing, this approach also offers one of the best means for minimizing the adverse effects of uncoordinated development.

Most cities have a number of powers they can use to give effect to their land use plans. Important among these are their powers to enact zoning ordinances, regulate subdivision standards, map the improvements to be made in undeveloped areas, and prescribe building and other codes. Unfortunately, many cities have tried to exercise these powers without any prior over-all planning. This approach should be discouraged. Every city should spell out its land use objectives in a master plan before it proceeds with the formulation and enforcement of a land use control program. And going a step farther, cities and adjacent local units of government should go out of their way to cooperate with each other in the development of integrated area plans that involve suburban and

rural-urban fringe communities as well as the central cities.

Detailed attention need not be given here to the uses made of zoning, subdivision, mapped improvements, and building standard regulations. Suffice it to say that these measures can be used to channel urban and suburban developments along desirable lines and to maintain minimum standards in new land resource developments. It should be noted at this point, however, that these measures emphasize a negative "Thou shalt not" approach. More positive programs are also needed if we are to do an effective job in guiding the suburbanization movement. In this respect, we should recognize that the average suburbanite has no deliberate intention of retiring prime agricultural land from use. He wants a tract of land that will provide a satisfactory home site. As a rule, he insists that this site be well drained, that it be located on or near an all-weather road, that there be adequate school and other community facilities for his children, that he have access to water and electric power, and that he either have access to a public sewer or have soil capable of absorbing the effluent from a septic tank.

It is no coincidence that many of the sites that fit these qualifications

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also have value for farming purposes. After all, our rural roads, power lines, schools, and other public services have been provided mostly in those areas where farmers lived. If we should decide that certain farm areas are to stay in agriculture, then positive programs should be developed to provide the roads and other facilities needed to make rougher and less fertile alternative sites attractive for suburban use.

Under the open market system of land pricing, there is little hope for holding suburban farm land out of suburban use. Individual owners may hold out for a time. But the lure of a substantial profit from the sale of land and the knowledge that agriculture cannot compete with the suburban buyer in the land market bidding process ordinarily leads to shifts in land use. This does not mean, however, that measures cannot be used to freeze farm lands or other open spaces in their present uses.

Insofar as society wants to keep some farms in permanent agricultural use and insofar as it wishes to label other farms or rural areas as greenbelts or open spaces, steps can always be taken to substitute social priorities in land use for our usual market price-determined priorities. Several tools can be used to this end. Exclusive agricultural zoning may be used to keep farmland in its present use. This approach is workable, but it is always subject to changes in the zoning ordinance and to the frequent whittling away at restricted districts that comes when potential buyers and sellers see advanages in shifting specific areas to other use classifications.

Long-term contracts could be worked out to guarantee land owners a low property tax rate as long as they keep their land in open uses and to make them subject to a sizeable delayed tax if they shift their lands to more intensive uses. Another lasting, and in many ways more satisfactory, arrangement calls for use of the public ownership, spending, and possibly the eminent domain powers to vest governmental units or community groups with all or part of the ownership rights needed to insure retention of certain areas as future open spaces. With this approach, a metropolitan district could purchase a farm and then lease it back to the farmer on a long-term basis. Arrangements could also be made to purchase or lease the development rights to given tracts. Public purchase of development rights has been suggested in many areas as an effective means for retaining greenbelt areas as open spaces in the years to come.

<sup>&</sup>lt;sup>5</sup>This approach is advocated by William H. Whyte, Jr., of Fortune magazine, and by Karl J. Belser, Director of the County of Santa Clara Planning Department. A recent report of the County of Santa Clara Planning Commission, From Roadside Towns to Greenbelt City: A General Plan for South Santa Clara County, 1958, designates a significant area in the county as a future agricultural greenbelt and suggests that state and federal grants—comparable to our federal aids for highway construction and for urban renewal programs—be used to help guarantee the survival of these areas.

### DISCUSSION: NONAGRICULTURAL AND RECREATIONAL USES OF RURAL LAND AND WATER

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W. DAVID HOPPER Ontario Agricultural College

In agreeing to undertake the task of preparing papers on so vague and amorphous a subject as the nonagricultural and recreational uses of land authors Johnson, Wooten, and Loomer have displayed unusual courage As Loomer so rightly points out, the whole field of nonagricultural land use, and more particularly the use of land and water for recreational purposes, involves the consideration of a host of intangible social and personal values which, for the most part, are clearly outside the generally accepted scope of rational economic analysis. To wander around in this thicket of irrationally patterned human behavior without the comfort of a trail blazed by a developed body of theoretical constructs takes considerably more than the usual level of courage which accompanies publication. It is to be hoped the example the authors have set in venturingwith considerable effectiveness-into this wilderness will embolden others to display similar vigor in attacking what, in my opinion, is the most significant land use problem in Canada and the U.S. at the present time. And if Wooten and Johnson are to be believed (and certainly the evidence is in their favor) this problem promises to become increasingly important at an accelerating rate in the future.

Johnson and Wooten have condensed an impressive body of statistical information on the nature and scope of the nonagricultural uses of rural land and water. By tracing the historical trends of both agricultural and nonagricultural uses, they provide the reader with a perspective and depth of understanding of both the present and probable future pressures on the land and water resources of the U.S. So far I can ascertain similar trends exist in Canada. One might wish for a few tables as an addendum to the paper. Comparing statistics which are interspersed with text is not an easy job.

The Loomer paper is largely conceptual in nature. It does an excellent job of sketching the broad outlines of the difficulties which will be encountered in developing an economic rationale to embrace the multiple facets of recreational land use. The paper is skillfully written. Just about the time everything looks bleak and fraught with despair, Loomer embarks on a most stimulating discussion of the research which might, indeed must, be done before very much can be said definitively about recreational land use.

Loomer suggests several possible classifications into which the supply of recreational land may be analyzed. He seems to doubt how far one may go with a comparable classification of the demand for recreational AL

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facilities. I would like to raise a note of protest at this point. It is my feeling that if the present records of the various park services were carefully analyzed, and if spot checks were made in the future on who is using what, certain characteristics of the consuming population would emerge which would allow at least a probability estimate of the kinds and acceptable locations of recreational facilities which a given population is likely to demand. Fish and game licenses can give a rough indication of the proportion of a population which can be expected to engage in fishing and hunting. Spot checks and a review of the park registrations will give some estimate of present demands for various types of public camp facilities. Surveys of private resort and camp operators will likewise add to the picture of demand. But in each case interest should focus on the likely numbers who are seeking a particular type of recreation facility. The fact that the fall hunter who looks for a duck marsh is also knocking on the gates of a family resort in July, and can be found every weekend trailering a boat to local launching sites must be recognized in a study of demand where he appears in three separate classes requiring three types of recreational supply-duck marsh, family resort, and water access. If the planners in the Ontario Department of Lands and Forests had some rough indication of the proportion of persons from the Toronto metropolitan area which fell into such categories, they would find their planning job moved from the area of abstract art to the incipient stages of a

I fully agree with Loomer that the nature of this demand will change rapidly, but once the initial difficulties of classification and enumeration are overcome, it should be possible to re-check the data for new estimates as well as indications of the nature of the changing patterns.

Both these papers have as their core the problem of the social control of land use. It has been my observation that one of the greatest impediments to the improved use of land, particularly the nonagricultural uses, is to be found in the confusion which surrounds the boundaries of authority and responsibility of the various agencies and levels of government. For those who are engaged in the rather messy job of making decisions on land use policies, or are responsible for implementing those policies, this confusion is more than disconcerting and frustrating; it too often leads to the complete collapse of sound land programs. The need for broad cooperation and close coordination is rarely so evident as it is in the development and bringing to fruition land use policies. The control and direction of land use requires the existence of a strong administration which is capable of uniting a wide range of governmental activities from health to highways, and which holds final jurisdiction over a large geographic area.

Such an administration must be based on a comprehensive set of laws,

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have a strong and stable financial base, and enjoy a clear mandate from the polity to carry out its assigned task. To obtain these requisites there must be a wider understanding of the nature of the land use problem, and a greater appreciation of the urgency of this problem particularly by those in legislative authority. It is significant that in response to the question: "What, in your opinion, is the foremost land use problem in Ontario?" several persons in both private and public agencies concerned with land responded with: "The foremost problem is to make those in authority realize it is a problem on which they must act, and act quickly."

I am impressed with this statement, Implicit within it is the frustration of men whose perceptions and concerns are at variance with the perceptions and concerns of those who dictate their work. But there is also within it a hope and an optimism that once freed of the weight of uncomprehending and unsympathetic authority these same men can successfully undertake the task which they see before them.

But the degree of success in shaping comprehensive land use programs that these men will enjoy depends not only on a change in the attitudes of those in authority. Loomer is right when he calls attention to the basic need for ". . . methods of economic analysis better suited for appraising recreational needs and resources." The planners' job will never be satisfactorily handled without such a set of analytical tools. And it is the responsibility of scholarship to fashion them. I do not believe that the land economist is equal to meeting this responsibility alone. It is time for him, the political scientist, the public health expert, the geographer, the sociologist, indeed the representatives of all the disciplines concerned with man and land to come down from their isolated office cubicles and honestly confront the awesome job of communicating with one another. From this must come a new appreciation and respect for the contributions which each can make to an understanding of the totality of man's relation to land.

### DISCUSSION: NONAGRICULTURAL AND RECREATIONAL USES OF RURAL LAND AND WATER\*

JOHN MUEHLBEIER
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It is common knowledge that federal and state agencies may acquire land by purchase or condemnation if the owner refuses to sell at the price

<sup>\*</sup> The views expressed in this paper are those of the author and do not necessarily represent the views of the Great Plains Agricultural Council, the Farm Economics Research Division, Agricultural Research Service, or the USDA.

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ssarily omics offered him. While the Constitution requires that an owner be paid "just compensation," the term is not defined in the Constitution nor in any legislation. It has thus remained for the courts to make interpretations and this they have done. The courts have defined just compensation as "fair market value," or the price a "willing buyer would pay a willing seller." The courts have ruled further that "consequential damages" that result from the taking, except "severance damages," are not compensable. One explanation for this is that compensation for property taken is presumed to be on the basis of a willing buyer-willing seller, and a willing seller would take such costs into account in the price asked. Why severance damages are considered compensable and other consequential damages are not, is not clear.

Many problems arose as various agencies adopted the practice of offering payment on the basis of "willing buyer-willing seller." Apparently, federal agencies, except TVA, have tended to place a rather narrow interpretation on the guides used by the courts.

More recently, considerable dissatisfaction has been expressed over the price offered by the states for land taken for new interstate highways. Even though the price offered may reflect the market at the time of taking, as displaced families compete with each other for land, the price is driven up and they are unable to buy comparable property with the money received. Also, in times of a rising market, the price of land has often increased considerably before a displaced owner has been paid and found a new farm.

The agencies have sometimes conceded that owners may not always have been offered enough for their property to cover expense to which they are put, nor enough to buy comparable property in the land market as displaced owners compete with each other for available farms. The agencies say that they have no authority to offer a more liberal settlement, and that they are bound by law to a narrow interpretation of "market value." TVA, however, contends that there is no such legal restriction and that it, or any other agency, may take all circumstances into account in deciding what to offer an owner.<sup>2</sup>

Owners like to feel that the appraisers are competent and are doing a thorough job. Sometimes this may actually have been the case but did not appear so to the farmer. There are several reasons for this.

Owners like to know when appraisals are made. In a study in South Dakota, only 20 of 46 farmers interviewed said they had been contacted

<sup>&</sup>lt;sup>1</sup> John Muehlbeier, and others, "Reducing Adverse Effects of Reservoirs," Agricultural Experiment Station, Kansas State College: Circular 293, October, 1952.

cultural Experiment Station, Kansas State College: Circular 293, October, 1952.

<sup>2</sup> Kris Kristjanson, "TVA Land Acquisition Experience Applied to Dams in the Missouri Basin," Agricultural Experiment Station, South Dakota State College: Bulletin 432, August, 1953.

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before the appraisal was made. The other 26 did not see the appraiser even though the agency reported that it had asked its appraiser to contact the owners. In contrast, TVA required its appraisers to obtain signed statements from the owner that the appraisal had been discussed with him. No exceptions were found.

Owners like also to see the breakdown of the appraisal value. To with hold the appraisal details tends to destroy confidence in both the ap-

praiser and the appraisal process.

I have long felt that the government needs to examine carefully (1) the multitude of problems that arise from present day large-scale taking of private property, (2) the positions taken by the agencies, (3) methods used in buying land, and (4) the existing and proposed piecemeal legislation for alleviation of problems. This could become the basis for a comprehensive legislative and administrative approach toward reducing the adverse effects of future takings.

One of our congressmen noted recently that "We have all heard complaints from city dwellers and farmers alike. . . . There is apparently universal acceptance that many injustices are being done. It is small solace to a displaced person . . . that his Government recognizes the injustice . . . but at the same time . . . does not know how to correct these inequities. Yet that is what he is being told." This congressman has introduced a bill to establish a commission to study the problem.

Whether or not a national study is undertaken, I would like to suggest several additional steps that would help to alleviate local impacts of land

takings.

I would like to see more educational work done among the people before land is taken. I would like to see the local people become more familiar with their legal rights, with the methods of purchase used by the agencies, with avenues of recourse when injustices arise, and the like.

It would alleviate the impact of purchase if agencies gave a little more attention to the convenience of farmers. Agencies could improve their public relations, not in the sense of supplying still more information on how good their programs are, but in showing consideration for the owners affected

There is a need for local people to work together and also with the

agencies on the problems that arise.

Some consequential damages, such as the cost of moving household goods or livestock and machinery, can be measured readily. Some agencies now have authorization to pay these costs.<sup>3</sup> There is no reason why all agencies should not be authorized to do so. In another category are the consequential costs that are not so easily measured. These include

<sup>&</sup>lt;sup>a</sup> Milton A. Pearl, Appraisal Journal, January, 1958.

loss from partial or total disruption of the firm as a going concern and risks assumed in trying to get re-established. But the time has come to make inroads into this field also.

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Some eason egory clude While I believe that adequate payment for land could result from application of the concept of "willing buyer-willing seller," its usage has been too narrow. Furthermore, we seldom have a willing seller, and the concept is not adequate unless it is interpreted liberally enough to provide payment for consequential damages. Hence, I would like to see agencies place more stress on making payments for land taken on the basis of cost of comparable property.

It should be possible to buy land, with only an occasional condemnation. TVA has demonstrated this. Some agencies tend too much toward allowing cases to go to court, possibly to protect themselves against charges of overpayment. The courts should not be used as appraisal agencies. The cost to the public of settling a case by condemnation is high and the courts are not staffed for this purpose.

# TECHNICAL PROGRESS AND VERTICAL INTEGRATION OF AGRICULTURE I

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Chairman: G. W. Luke, Rutgers University

### DYNAMICS OF THE INTEGRATION OF AGRICULTURAL PRODUCTION AND MARKETING

H. K. LECKIE

Meat Packers Council of Canada, Toronto

THE TERMS agribusiness, vertical integration and contract farming, have become more or less ubiquitous in current agricultural economics literature. Moreover, there is evidence that integration is not simply regarded as a conversation piece but as a developing trend of wide significance to the whole agricultural industry and, in particular to animal agriculture.

In common with other developments which impinge on the institutional structure of farm marketing, intregration has its controversial aspects. There seems to be quite a tendency to approach it with a strong negative or positive bias and to form hasty value judgments without examining all the facts. As a result, in one extreme view, it is a "bogey" being foisted on the farmer that must be strenuously resisted. As opposed to this, there is the view that integration is the magic key to greater efficiency and security and an inevitable concomitant of technological progress. But both opponents and protagonists seem to agree on one point, namely, that integration is definitely here and is on the increase.

Most talks and articles on vertical integration start with a definition of terms, the accepted legislative pattern. In its present context, I believe it is generally agreed, integration refers to a coordination of management decisions extending over two or more stages in the production-marketing process. This is the interpretation advanced by Scoville¹ and others. It need not, as Engleman² has pointed out, imply complete economic integration and control through full ownership. The type of situation which is commonly being discussed today is integration by means of various forms of voluntary contracts or, in some cases, by cooperative business arrangements. No matter how it is effected, integration generally connotes joint decision making and joint risk bearing, as George Mehren has pointed out.³

<sup>&</sup>lt;sup>1</sup> Orlin J. Scoville, "Agricultural Integration—Its Implications for the Future," remarks to Farm Editors Association, May, 1958.

Gerald Engleman, "Integration in the Livestock Industry." Paper presented to

Southwestern Social Science Association, April, 1958.

<sup>3</sup> George L. Mehren, "How is the Market Made in Integrated Industries?" Talk at National Institute of Animal Agriculture, April, 1958.

There has been quite a tendency to use vertical integration and contract farming interchangeably. They are not, of course, exact synonymns. Earl F. Crouse, who has spoken and written extensively on this subject, puts it this way:<sup>4</sup>

Contract farming, as we think of it within the vertical integration concept, is like the flux used by the blacksmith in welding the links of a chain. Contract farming, therefore, refers simply to the instruments or methods used in creating the links in a marketing chain for farm products which, when complete, includes the supplier, the farmer, the processor, the wholesaler and the retailer—a marketing chain that reaches all the way from the farm to the city and back again.

The exact form of the contract and whether signed or unsigned is not important to this basic concept. The function of these agreements and contracts is always the same. They bring suppliers, producers, processors and distributors together on the basis of common objectives . . . in harness on the same team

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So much for definitions. The important questions to which economists are, as they should be, seeking answers are: How much integration do we have and how fast is it developing? What are the dymanic forces in the whole field of agribusiness behind this development? What are its implications? This paper is limited primarily to a consideration of the first two of these questions which are, of course, fundamental in approaching the third.

#### Developments in the Field of Integration

The economic history of agriculture clearly shows that the idea of integrated production and marketing is as old as the industry itself. At the outset, agriculture was pretty completely integrated from the "bottom up," as the common expression goes. Most of us would not have to go back too many generations in our family trees to find a progenitor who was a farmer producing for a specific market and who supplied most, if not all, of the processing and other services required all along the line.

From this relatively uncomplicated but fully-integrated pioneer farm economy, the agricultural industry passed through a dramatic period of growth and development. As production became more specialized, the production-marketing process became more roundabout and complex, with other agencies constantly entering the picture to provide functions and services ancillary to a commercialized agriculture. The result was "agribusiness," to use the rather apt term coined by John H. Davis.

In this process of specialization, basic decisions relating to food production and marketing become widely diffused among countless individuals and firms operating in a free enterprise, competitive economy, which rely heavily upon open market prices to equate demand and

<sup>&</sup>lt;sup>4</sup>Earl F. Crouse, "Vertical Integration in Agriculture." Talk at 49th annual meeting of American Railway Development Association, April, 1958.

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supply and to direct resources. But almost as soon as the elaborate central marketing structure evolved, the irresistable forward march of technology began to point up various inefficiencies and diseconomies. Short cuts and bypasses became increasingly frequent, particularly in the case of products with special production and market characteristics.

Contract arrangements for vegetable canning crops, sugar beets and certain tree fruits, have now been an accepted practice for a number of years. The resulting assurance to producers of a market at a predetermined basic minimum price and to processors of a supply related to their capacity and customer requirements, has been mutually advantageous. For these products annual bargaining as to contract terms has replaced the open market.

In the dairy industry at least partial integration is indicated by the prevalence of fluid milk shipping quotas and the growing practice of determining prices according to an accepted formula. In Ontario and British Columbia, milk price formulas seem to be working smoothly, and the same, no doubt, applies in many other North American markets. The introduction of bulk milk handling is another indication of integration in this particular industry. Cooperative dairies, creameries and other dairy processing plants are evidence that dairy farmers have not relied entirely on contract forms of integration.

Most people seem to agree that the poultry industry provides the outstanding example of integrated development, particularly within the last two decades.

A very high proportion of one of the industry's two main products, poultry meat, is conceded to be produced under contract in both the United States and Canada, and there seems to be quite a general opinion that the second product, eggs, is a natural for integration.

The spectacular increases in broiler meat output which have accompanied the spread of contract production in that industry are common knowledge. In the United States, statistics show that output, which was only 100 million pounds in 1940, had tripled by 1948, doubled again by 1950 and by 1955 was up to approximately a billion pounds or 10 times the 1940 output.

A similar trend has developed in Canada. While the absolute figures are less impressive, Canadian commercial output of broiler meat in 1957 was 125 million pounds, compared to only 30 million pounds in 1953.

In the case of turkey meat production, integrated production and marketing plans have also become increasingly prevalent and have been associated with an important expansion in this industry. According to a press report, construction was recently started near Exeter, Ontario, of a turkey hatchery, Canada's largest. It was indicated the hatchery and an

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associated company, North Land Turkey Farms Limited, plan to contract with farmers for an output of 10,000 turkeys a week. This is, of course, just one example.

An impressive example of cooperative integration in commercial poultry production and marketing is afforded by an article in Feedstuffs magazine, relating to the Poultry Producers of Central California (PPCC).5 This cooperative, in operation since 1926, operates five feed mills with 50 branch outlets and has nine egg grading and packing plants served by a fleet of refrigerated trucks. In 1956, sales of feed, farm supplies and petroleum products by PPCC totalled \$26 million, with its egg sales grossing \$27 million. The cooperative does not write contracts with members for eggs, broilers or turkeys but extends 30-day credit and, for longer periods, resources of the Poultry Producers Federal Credit Union are utilized. The latter loans are generally secured by chattel mortgages on flocks. PPCC General Manager L. N. Thompson, with reference to integrated plans that have price or income guarantees, states, "These features, we feel, are undesirable because they tend to insulate the producer from the normal effects of supply and demand circles . . . we do not guarantee them a profit but we place in their hands the tools they need to aid them in obtaining a profit."

Although this example indicates that forward-looking and aggressively-managed cooperatives are playing a part in the integration of poultry production and marketing, the bulk of output is undoubtedly through contracts offered by commercial feed firms and poultry processors. Competitive factors naturally preclude wide publicity as to the nature and extent of these operations, but detailed economic surveys, such as conducted by Hansing in lower Delaware<sup>6</sup> last year, help to round out the picture. A previous study by the Agricultural Marketing Service was also informative.<sup>7</sup>

With integration in the poultry industry having demonstrated such potentialities, the adaptation of similar techniques to the production and marketing of meat animals is now a major center of interest. The hog industry seems to offer particular opportunities for the rapid growth of integration and there is evidence of a strong trend in that direction. Contractual arrangements in cattle and lamb feeding are by no means new, and even more integration in these operations seems to be probable, not

<sup>&</sup>lt;sup>5</sup>L. N. Thompson, "We Have Our Own Integrated Plan," Feedstuffs, February, 1958 p. 46

<sup>&</sup>lt;sup>6</sup> Frank D. Hansing, "Financing the Production of Broilers in Lower Delaware," University of Delaware, Bulletin 322, October 1957.

University of Delaware: Bulletin 322, October, 1957.

<sup>†</sup>A.M.S. Bulletin No. 183, USDA, "A Summary of Selected Recent Studies in Broiler Financing and Contracting."

just possible. With larger meat animals, capital and risk factors are, of course, much more formidable than in poultry.

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A very interesting symposium on various aspects of the integration potential in the whole field of animal agribusiness took place at Purdue University in April under the auspices of the National Institute of Animal Agriculture (NIAA). Stimulating papers by Kramer, Butz, Crouse, Mehren, Sadd, and Wilson<sup>8</sup> touched off an interesting discussion of the present and prospective impact of integration on various segments of the livestock and meat industry.

As in other farm enterprises, integration is certainly no new thing in animal agriculture. Cooperative livestock feeding and shipping associations have, for many years, operated with considerable success in integrating the primary stage of production and marketing. Efforts by producers to extend integration into the processing and distribution field have been, on the whole, much less successful, although in Canada cooperative processing plants are in active operation in Ontario and Quebec and have been for some years. Plans for another cooperative abattoir are also well advanced in Nova Scotia.

The really dynamic and challenging aspects of vertical integration in animal agriculture today relate to dramatic advances in production technology, particularly feeding, breeding and automated management. The first stage of the current industrial revolution in agriculture mainly affected field crop production. Productivity per man sharply increased through the use of power tillage and harvesting equipment, improved varieties, heavier fertilizer applications and better weed, insect and disease control. While all this was going on, the livestock industry was increasing its efficiency but at a much more leisurely pace. According to estimates by the U.S. Department of Agriculture, output per man hour from 1910 to 1956 increased by only 25 per cent in meat animals but by nearly 350 per cent in feed grain production.

Now, however, there is every indication that animal agriculture is having its innings and a concentrated drive toward increased scale and efficiency is beginning. As a result of a cooperative research project at the Illinois agricultural experiment station, facilities have apparently been devised for using electronic controls in automatically providing hogs with a constant supply of feed and water, ensuring sanitation by periodically flushing an exercise area and disposing of waste into a septic tank. Feed in-

<sup>&</sup>lt;sup>8</sup> R. C. Kramer, "What is Integration and Its Current Status?"; E. L. Butz, "The Social and Political Implications of Integration"; E. L. Crouse, "Why Is Integration Developing in Agriculture?"; G. L. Mehren, "How Is the Market Made in Integrated Industries?"; C. W. Sadd, "Impact of Integration on Agricultural Product Marketing"; and N. A. Wilson, "How Does Integration Affect the Farmer?". Talks presented at National Institute of Animal Agriculture Conference, April, 1958.

gredients are stored in separate bins, automatically conveyed as required to an electronically-controlled mixing plant and, after grinding and mixing, directed to feeders by a high-pressure pneumatic system.

As proof that there is nothing fantastic about such developments, there are plenty of examples encountered on every hand of at least semi-automatic hog and steer feeding installations, designed and built in many cases by practical farmers with an eye to saving labor and cutting costs through

larger volume.

Recent sensational advances in livestock breeding, feeding and management, with more and more stress on performance testing and stock tailor-made for market specifications, have opened wide the door to various forms of production-marketing contracts and other integrating devices. With feed a major livestock cost factor, and one of increasing importance as labor productivity increases, feed suppliers, both private and cooperative are in a stretegic role to supply the integrating speak.

tive, are in a strategic role to supply the integrating spark.

In our discussion of integration to this point, most attention has been

In our discussion of integration to this point, most attention has been directed to the function that contracts and cooperatives have in this development. There is, however, another factor in the field which cannot be ignored. I refer to government. Various types of marketing legislation, including price support programs, certainly affect production and marketing decisions. In Canada the Wheat Board provides producers with forward minimum price guarantees, imposes delivery quotas, and takes charge of the whole marketing operation, with the exception of purely local transactions. The present Agricultural Stabilization act provides mandatory basic minimum price supports for nine key commodities, including cattle, hogs, sheep, butter, cheese, eggs and grains not under the jurisdiction of the Wheat Board. Supports for other commodities can be and are being provided, as deemed necessary.

It seems quite clear that government, when it actively engages in, or underwrites, the marketing of farm products, is certainly performing the functions of an integrator, viz., assuming risk and taking over major responsibilities in decision making. Certain support policies, as we shall

note later, are also conducive to integration by private agencies.

There is another area, namely producer marketing legislation, which is of particular interest in Canada at the present time. Within the last 20 years all provinces have enacted farm products marketing acts which establish government marketing boards and provide for commodity groups to hold plebiscites on proposed marketing schemes. If sufficient support of the producers concerned is indicated, a marketing scheme may be established under a local board. The latter is given wide powers to regulate the marketing and sale of the product, in some cases through one central sales agency which, in effect, becomes a "compulsory" cooperative. In the prov-

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ince of Ontario, for example, there were during 1957 some 16 marketing schemes in effect, covering 28 products with an annual sales value of approximately \$223 million. Under the Milk Industry act, products with an additional value of \$72 million were covered.

While marketing boards do not assume any price risk, their wide powers (including licensing, market direction, price fixing, allocation, and a potential, but to date, generally unexercised, power to regulate output by quota), certainly warrant their mention in a discussion of integration, Reference to possible effects marketing boards may have on contract farming will be made later.

#### Important Factors Behind The Integration Trend

Any constructive approach to integration obviously entails an identification of the basic factors which seem to be inducing it. Obviously, such an analysis should include consideration of factors which inherently predispose farm production and marketing to integration, as well as any extraneous forces which afford extra impetus or incentive.

A review of current literature yields rather striking evidence of a considerable diversity of opinion as to which causal factors are of greatest significance.

Here, for example, are quotations from the addresses of several keynote speakers at the 1958 meeting of the NIAA held at Purdue.

In his paper, "Why Is Integration Developing in Agriculture?" E. F. Crouse said:

"The real big moving force behind the integration movement, as I see it, is the change in the retail outlet. Supplies must be lined up in volume and quality to meet the demand of the buyer and, to guarantee this, suppliers are willing to enter into contracts with farmers."

George Mehren, in discussing "How Is the Market Made in Integrated Industries?" had this to say:

"A major reason for the appearance of this kind of market co-ordination is the incapacity of the old open price markets to assure the products and delivery terms essential to the various newer types of enterprises and functions which have recently appeared."

A third speaker, E. L. Butz, began his talk on "The Social and Political Implications of Integration" as follows:

"Vertical integration in agriculture is the result of fundamental economic and technological changes occurring in the agricultural industry—not the cause of them. It is a manifest effort by individual sectors of the agribusiness assembly line to survive in the swift competitive current of our modern dynamic food and fibre industry."

Another conference speaker, R. C. Kramer, listed nine important motivating forces which influence farmers, feed companies, processors, dis-

tributors and other industry groups to join in the integration movement. Kramer noted that the profit motive was basic in each instance.

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In a paper delivered at another meeting<sup>o</sup> prior to the animal agriculture conference at Purdue, Orlin J. Scoville listed eight factors conducive to integration—three factors influencing processors to make contracts, three making farmers receptive to them, one motivating farm suppliers, and one general factor, viz., desire to improve efficiency of resource use in farm production, thus motivating agribusiness as a whole.

Before seeking to weigh or evaluate the relative importance of various forces, one may find considerable merit in trying to deduce logically the economic motives which incline various sectors of agribusiness toward integration.

First, let us consider the individual farmer. For what reasons may he be willing to exchange some of his cherished traditional freedom and independence in deciding what to produce and how and when to market it? I suggest some of the reasons may be as follows:

- (1) An important shift in the balance between capital requirements and its availability and labor-management resources.
- (2) A feeling of financial insecurity in the face of larger investment and price and income instability within the framework of the traditional marketing system.
- (3) A conscious need for sound technical advice and practical management suggestions for improved efficiency.
- (4) A desire to increase volume of business to raise net income and reduce costs.
- (5) The assurance of a ready market and full recognition of quality differentials.

The foregoing, while probably not an exhaustive list, seems to me to include some of the important reasons why the average farm operator is rather receptive to practical propositions which seem to offer assistance in solving short term credit problems and which, by reducing risk, furnishing technical advice and guaranteeing a market, may allow him to invest in capital improvements with greater confidence. In general, he is likely to consider a contract if he feels it may give him greater scope to develop his managerial potentialities.

Underlying these practical considerations, there seems to be a growing number of farmers who feel that the traditional methods of marketing and price determination are no longer entirely adequate in a period of dynamic change. Having also had an opportunity to assess the shortcomings of various political panaceas, producers tend to be receptive to direct approaches

<sup>&</sup>lt;sup>6</sup> Orlin J. Scoville, "Where To in Agriculture-Business Integration?" Talk to Association of Southern Agricultural Workers, Little Rock, February, 1958.

to the problem of more closely integrating production and marketing. In the case of products which do not require extensive processing, the cooperative approach presents considerable appeal. Where extensive investments in processing facilities are involved, integration by contract seems to offer an alternative, practical solution.

Turning next to the food processor, what factors incline him toward in-

tegration? Some of the major ones may be:

(1) The required assurance of a supply of raw materials of sufficient quantity and desirable quality to efficiently utilize plant, equipment and personnel throughout the year and reduce operating costs.

(2) Demands by domestic and export customers for processed prod-

ucts of uniform specifications and in regular supply.

(3) Desire to expand and diversify operations and to obtain cost or

quality advantages over competitors.

As at the primary production level, there have been important technological advances in food processing which require substantial new capital investments in plant and equipment over and above the general expansion required to keep in step with population growth and resulting larger food consumption. In order to keep pace with important developments in food distribution at the retail level, food processors have had to greatly expand the range of services "built-in" to their products. Prepackaging and frozen foods are good examples. With a high proportion of food purchases now made in self-service supermarkets, "specification buying" has become general and processors must be in a position to supply branded lines of products of standardized quality in large volume at realistic prices.

It can be readily seen how these factors impinge on the food processing industry and are causing a re-examination of raw material procurement policies. But, nevertheless, I believe there is a general reluctance by food processors to consider complete vertical integration, extending into the

primary production field, except as a final resort.

In fact, as long as there is an adequate supply of farm products available on competitive markets, I think most food processors would prefer to continue securing their requirements in this way. But where continuity of supply, quality considerations or special competitive situations due to plant location or other factors assume vital importance, processors, no doubt, are inclined toward a consideration of integration by contract, which, after all, is what sugar beet refineries and canneries have been doing for years.

There are at least two other sectors of agribusiness which are, or could become, actively involved in integration. I refer to retailers and farm sup-

pliers, particularly the feed industry.

As previously indicated, changes in retail food distribution which are of

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course closely related to the demonstrated buying habits of consumers, are considered by some authorities to be the factor which basically lies behind the integration trend. While there has been considerable tendency for large retail food organizations to integrate vertically by acquiring their own food processing units, marketing service agencies and even in some cases their own farms or feed lots, it is probably fair to say there has been some reluctance to go too far and too fast in this direction. The necessity for heavy investment in new retail outlets and the possibility of political and other considerations are factors to consider. In any event, in the foreseeable future, we may perhaps assume that the retailer's main influence on extent and speed of integration developments in the agricultural industry will be exerted through his buying and merchandising policies. After all, his main objective is the creation and satisfaction of demand for a large and stable volume of food, of a quality in a form and at a price acceptable to consumers. Retailers may be expected to adopt policies which aid in achieving this goal, which is not inconsistent with the aims of the agricultural industry as a whole.

With respect to farm supply agencies, the position is somewhat different. There seem to be no question that the feed industry is paying a positive, even aggressive, role in contract integration in the livestock industry, just as has been the case with poultry. It is not difficult to see why this is so. There have been sensational advances in animal nutrition in recent years. I think there is good reason to believe that these advances have been responsible, to an equal or probably greater degree, for increased productivity in animal agriculture than advances in animal breeding and management have been.

With feed a major input factor in meat animal production and with the latest findings of nutritional research becoming available at a faster rate than the average livestock producer can absorb them, feed manufacturers and dealers are placed in a strategic position to offer package plans, including credit, management supervision and various degrees of risk bearing.

The primary objective of the feed companies or distributors offering these plans is, of course, to secure a larger and more stable market for their particular products and, incidentally, to build cutomer good will. While in the long run the demand for commercial feed is derived from the demand for livestock, which in turn is directly related to the demand for the products processed from livestock, there appear to be some dangers in the short run resulting from wholesale negotiation of feed contracts, particularly some forms of them. I refer particularly to the possibility of sudden sharp increases in supply and resulting market dislocation.

The foregoing represents an attempt to identify some of the factors

which seem to be conducive to integration and which are likely to result

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Before concluding, I would like to refer to the possible effect of legislative programs. In the case of commodities, for which forward minimum price guarantees are provided by government, it would appear that such programs may very well tend toward the extension of contract farming, Perhaps I may use the current Canadian stabilization program as one example. Under the present act, a floor price in the current year equal to at least 80 per cent of the average of the previous 10 year period is manda. tory. The board may, in any year, prescribe a price higher than this minimum, taking production costs or any other relevant factors into considera. tion. With this in mind, those interested in hog production, for example, are in a position to know the minimum price they can expect for not only one year in advance but, considering the 10-year base price formula, but also get a fair idea of the floor for two or more additional years. The effect of this situation remains to be seen, but it makes an interesting speculation. It may, of course, be argued that with greater price assurance the producer will not find contracts so interesting. This, however, may be offset by a desire to rapidly expand facilities, with ready production credit a strong inducement.

Another interesting question is the effect the possible growth of producer marketing boards may have on integration. One argument being advanced is that for products covered by a marketing scheme of the central sales agency type, contracting will be effectively curtailed because of the inability of a producer to deliver his product to a specific processor due to the powers of compulsory direction exercised by his agency. This, of course, would not necessarily affect contracts arranged by a feed company, provided that no specific delivery outlet was stipulated. But it might tend to promote contracts between producers and processors where title to the product would be vested in the latter and no ownership transfer would be involved at the time of final delivery. It is not clear that agency type marketing schemes, while involving a certain amount of integration within themselves, will necessarily slow down the trend of contract deals. Concerning the alternative type of marketing scheme which involves annual collective bargaining, this virtually amounts to contract farming on

an industry-wide basis.

There is always the strong possibility that artificial market regulation of any sort may become too oppressive or confining and unduly impede the natural flow of commodities through traditional marketing channels. When this happens, complete economic integration, rather than contract farming, may be increasingly turned to as the only practical alternative.

There is no disputing the evidence that agriculture has already pro-

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ceeded a considerable way down the road to integration and recently at an accelerated pace. Although this trend may shift in speed or direction, it seems probable there will be no turning back.

# DISCUSSION: DYNAMICS OF THE INTEGRATION OF AGRICULTURAL PRODUCTION AND MARKETING

FOREST L. GOETSCH, AFEA Doane Agricultural Service, Inc.

Mr. Leckie has given us a very comprehensive summation of recent developments in vertical integration, plus a number of reasons why it is now taking place in agricultural production and marketing.

The term "dynamics" is very appropo in any discussion of vertical integration or contract farming because of the unusual speed with which these developments are taking place.

We have become accustomed to the general statement that over 90 per cent of the broilers in the United States are produced under some type of integrated program. However, it was something of a shock when a recent Wall Street Journal article stated that 20 per cent of the nation's eggs are now being produced under contractual arrangement. Many companies prefer to list their activities under the label of a "quality egg program" or other name.

To further underscore the dynamic nature of this topic, I would like to point out the recent movement of production and marketing contracts into the swine industry. Several of the biggest feed companies in North America are cooperating right now with major meat packing concerns in experiments designed to bring forth a mutually advantageous working agreement between supplier, producer and processor.

In my opinion, the major pressure for integration in this area will come from the packers. The main reason can be drawn directly from Mr. Leckie's paper, "The required assurance of a supply of raw materials of sufficient quantity and desirable quality to efficiently utilize plant, equipment and personnel throughout the year and reduce operating costs."

Several of Mr. Leckie's reasons for farmer interest in such contracts are very applicable to the hog business. He mentioned the shift in the balance between capital requirements and labor-management resources, the feeling of financial insecurity in the face of larger investment and the price and income instability with the old marketing system, the need for sound technical advice and the desire to increase volume of business.

Our Doane engineers are finding that farmers are very interested in the new confinement hog raising systems, but the investment in buildings and

equipment usually runs from \$10,000 on up. A farmer making this kind of investment is interested in any kind of marketing contract that will give

him a measure of security.

Of course the feed people are in this picture too. It is a very competitive business and each company aims for as much tonnage as possible. If one company offers some type of financing on feed, then others must soon follow suit.

Broiler and turkey growers use a complete mixed ration, delivered in bulk from the feed mill. This means that purchased feed is a major input factor in production. The traditional Midwest swine producer has been growing his own grain and buying only protein supplement. This was not a large enough tonnage to induce feed companies to set up elaborate

financing plans.

More recently swine production has been increasing rapidly in some of the grain deficit areas of the southern U.S. Favorable barge rates allow feed companies to move grain in from the Corn Belt, mix a complete ration and deliver it to the southern farmer's confinement feeding floor. The cost is low enough so that, along with the increased feed efficiency from complete mixed rations, the producer is in a position to compete favorably with pork from northern states, unless it is produced under the same efficient methods.

Adding all these factors together, I am sure Mr. Leckie was right in his conclusion that, "There will be no turning back" from the road to integration which agriculture is now traveling. Perhaps he was even a little conservative in his presentation with regard to how far we have come and how

fast we will continue to move ahead.

However, I do not doubt his wisdom in indicating that Canadian agriculture may move somewhat more slowly because of the government's forward pricing program and the possible activities of producer marketing boards. However, these two programs are both aimed primarily at helping the producer and do not achieve any of the ends desired by the supplier and the processor, with perhaps the exception of the swine marketing group's real interest in providing a meat-type hog.

In the United States, there seems no doubt that there will be more vertical integration in the poultry industry with eggs seeing the greatest increase in the near future. Contracts with swine producers will certainly be more numerous, especially in 1959 when hog prices will be less favora-

ble to growers.

Contract feeding of beef cattle is common in much of the West already. Now Armour and Company has announced a new program that involves the cattle producer. He can have his beef cows artificially inseminated with semen from a high quality bull at no cost to him, if he agrees to sell So-ca By have its d

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Armour the calves as weaners or yearlings at "full market price," plus one cent per pound premium.

This is definitely an attempt to procure the right type of beef for the

so-called "specification buyers" of the chain store.

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ready. volves inated to sell By a few illustrations of specific developments in vertical integration, I have attempted to confirm many of Mr. Leckie's statements in regard to its development and the reasons behind it. Certainly I have no basic disagreement with his ideas as presented.

#### CREDIT IMPLICATIONS OF INTEGRATION IN AGRICULTURE

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ROM TIME immemorial merchants, processors and other middlemen have found it expedient and even desirable to finance some of their customers. The granting of credit has been a means of gaining or holding patronage and establishing other business relationships. It is not unexpected, therefore, to find that financing has played a major role in tying together some of the component units in vertical chains. The firm taking the initiative in organizing a vertical grouping frequently must furnish a substantial part of the capital needed by other units joining the chain. This has been an important factor in horizontal integration as well.

The form and extent of financing vertical integration in agriculture vary widely. To a considerable degree the credit phases are similar to and have about the same problems as merchant credit. In many grower-processor or grower-dealer links, the processor or dealer, whom we shall refer to as "contractor," sells needed supplies to affiliated growers on terms very similar to the most ordinary credit terms. As new forms of relationships have developed between contractors and growers, however, new methods of making capital available to growers have evolved. Modifications in the contract arrangements permit growers to use capital furnished by the contractor without taking on the usual obligations of a debtor. Some arrangements, in fact, involve a full release of credit obligation on the part of the contractor.

It is the purpose of this paper to examine the nature of these financing arrangements and to explore their implications. We will begin by reviewing the place of dealer or merchant credit generally so we can see the extent to which this has been modified in connection with contract farming. We can see the new financing pattern in the broiler industry and elsewhere where capital is made available on a different basis. Finally, we will suggest what these trends may mean to farmers, lenders, and the general pattern of financing agriculture.

#### Merchant or Dealer Credit

Virtually every merchant, dealer, processor or other type of middleman is under pressure to give some of his customers time to pay for their purchases. If the customer is unable to pay in cash, then either the middleman must let him have the goods or services with the promise to pay later, or the customer must borrow elsewhere so he can pay in cash, or the customer does not buy at all and the middleman makes no sale. Fre-

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quently when the sale is lost, the customer goes to someone else who will sell on credit. These are elementary but fundamental facts of life in the business world.

Many, if not most, middlemen prefer not to sell on credit. They favor cash sales so they can concentrate their efforts on their main business—selling feed, fertilizer, and other supplies or services farmers use. Granting credit is a separate, frequently unfamiliar enterprise requiring special servicing, extra bookkeeping, additional capital or loans from a specialized lender, and is a source of accounts receivable or payable that does not look good on the financial statement. There are collection problems also, frequently accompanied by unpleasant relations with customers. Finally, there are likely to be losses from accounts which cannot be collected in full and which probably stemmed from a poor credit policy. Some of these losses may have originated from customers who had been unable to obtain credit from specialized lenders and therefore represent less desirable credit risks.

This problem has plagued supply cooperatives, dealers and other middlemen of all kinds since they came into existence. Efforts to stay on a cash basis have been prone to break down because of failure to educate patrons and to establish a cash-and-carry policy. The result is loss of business to competitors who furnish credit. Much educational work has been done and much more needs to be done. Farmers point out that merchant credit is expensive, that interest costs on credit from production credit associations, banks or other specialized lenders are less and that discounts can usually be obtained if one has the cash so that he can shop around and find the lowest price.

Numerous studies have shown the substantially higher interest cost of merchant credit. One of the more recent studies is that made by the Tennessee agricultural experiment station. This shows that in the 3-year period 1954-56 the true annual interest cost of dealer installment credit to farmers averaged nearly 18 per cent compared with 7.6 per cent on commercial bank loans and 6.7 per cent on production credit association loans. Studies by the Farmer Cooperative Service indicate credit costs of 13.5 to 15 per cent on average accounts receivable of supply cooperatives which have better than average methods for controlling credit.

In spite of such facts and educational efforts, many farmers still prefer the convenience of merchant credit. Dependable data on the amount of merchant credit used by farmers are not available but the total is no doubt

<sup>&</sup>lt;sup>1</sup>J. Thomas Romans, "Knowledge and Attitudes of Tennessee Farmers Concerning Credit Practices and Some Effects on Credit Management and Credit Cost," a thesis submitted to the Graduate Council of the University of Tennessee in partial fulfillment of the requirements for the Degree of Master of Science, December 1957.

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substantial. The Tennessee study indicated that the amount of merchant credit used exceeded the amount of production credit association loans. The total of these loans outstanding in the United States is now about \$1 billion. The Agricultural Research Service, U.S. Department of Agriculture, estimates that non-real estate loans to farmers from merchants, dealers, individuals and similar miscellaneous sources total about \$3.5 billion.

Dealers and supply cooperatives have tried various means of providing credit without having to carry it on their own books. One device is to set up a separate credit cooperative or corporation in the manner used extensively in automobile financing. This approach has been used by a few farm supply cooperatives in financing time sales. Farm cooperatives also have sponsored formation of nearly 300 rural credit unions, some of which finance sales by the affiliated cooperative. In 1957 J. I. Case company set up a credit corporation for the purpose of financing credit sales made by dealers, and it was reported that Deere and company with over \$100 million of installment paper on its books was considering a similar step.<sup>2</sup>

When a separate financing agency is established, the initial capital will ordinarily be furnished by the parent firm. Lending funds are obtained by rediscounting customer notes with or borrowing through regular banking channels. In some cases, especially if the financing agency is organized by a cooperative, it may obtain funds by rediscounting with a federal intermediate bank and, under certain conditions, it may also borrow from a bank for cooperatives.

In many, if not most, instances, however, the cooperative or other middleman making credit sales is likely to carry the credit itself as an account or note receivable among its assets. For many years farm machinery manufacturers carried their dealers' notes. Of course, any middleman or manufacturer who finances his customers will in turn require financing, usually obtained from the larger city banks. In the case of cooperatives, required financing may be obtained from banks for cooperatives. Banks for cooperatives, however, have found it necessary in some cases to give special attention to borrowing cooperatives which furnish credit to their members. The accumulation of accounts or notes receivable tends to tie up capital and this may hamper the cooperative in carrying out the major purposes for which it was organized. Frequently there is a poor credit policy resulting in an accumulation of weak assets having potential losses.

An experiment carried out during 1957 in the St. Paul Farm Credit district has suggested a solution to the accounts receivable problem. Production credit associations worked out agreements with supply cooperatives

<sup>&</sup>lt;sup>2</sup> Ira U. Cobleigh, "Plow Shares," Commercial and Financial Chronicle, March 27, 1958, p. 4.

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for handling credit sales. Two alternative financing plans were offered to cooperatives. Under one plan, the cooperative guarantees farmers' notes to the production credit association covering the credit sales. Under the other plan, the cooperative agrees to set up a reserve or guarantee fund equal to 5 per cent of the total amount of the account. Any losses not covered by the reserve are absorbed by the production credit association. Under both plans, the cooperative finances the purchase of any production credit association stock that may be required to support the loan. Except for the larger loans, the necessary arrangements with the farmer are made and documents executed at the time of the sale. This avoids the necessity of the farmer going to a specialized lender and making separate arrangements for a line of credit.

The pilot operations in 1957 have been successful and the idea is spreading rapidly in the St. Paul and other Farm Credit districts. It promises to provide one satisfactory solution to the problem of financing credit sales. The farmer buying supplies or other services gets credit with a minimum of inconvenience to him. The cooperative does not have to get into the credit business and tie up working capital in accounts or notes receivable. Instead, the credit is furnished by a specialist who wants such business. So far there seems to be no important reason why this financing plan cannot be made to function for either cooperatives or other middlemen selling merchandise or services to farmers.

### Adaptation of Merchant Credit to Vertical Integration

All of the merchant credit arrangements just reviewed have been utilized in contract farming and other phases of vertical integration. Likewise, most of the problems which have been encountered in financing credit sales are also involved on even a larger scale.

In examining the adaptation of merchant credit to vertical integration, attention should be called first to the fact that the organization of farmers into a cooperative to perform a supply or a marketing funcion is itself a beginning of vertical integration. It establishes an organized link in the flow of product from producer to consumer. Hence, the financing aspects and problems for supply cooperatives discussed perviously represent one part of the credit aspects of vertical integration.

Integration takes on a more advanced form when growers enter into specific production contracts with a dealer, canner, processor, or packer. As one means of inducing farmers to enter into agreements to produce for market or according to his specifications, a contractor will offer to finance a part or all of the grower's production expenses. Feed companies, for example, may furnish feed on credit to producers of turkeys or eggs or to cattle and hog feeders. These are cases where the grower takes title to the poultry or livestock and also becomes the owner of the feed and

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other supplies which he buys. As an owner he can give a chattel mortgage as security for the debt if the feed dealer requires such security. These are sales where credit plays an important part in building a market and attracting customers.

Fruit and vegetable processors and canners for many years have had a variety of arrangements for furnishing or advancing the cost of fertilizer and some other expenses to growers who are producing for them under contract. Likewise in the cotton industry where vertical integration is well developed, it is common practice for the commercial (noncooperative) cotton gins to provide production credit to growers under contract. It is common arrangement for the cotton gin to lend a specified amount to the grower at a stated rate of interest to cover production expenses. The grower in turn may agree to sell to the gin enough cotton at an agreed price to repay the debt. He may also agree to have all of his cotton ginned at the gin furnishing the financing. In other instances, in return for financing, the grower merely agrees to give the gin the opportunity to buy the cotton at a price comparable to that which the grower may be able to get elsewhere.

The cooperative cotton gins generally do not finance growers. The co-op gin may refer its members needing credit to the local production credit association. In other instances the grower will obtain his loan from a bank. In the delta area, the Staple Cotton Cooperative association, a marketing cooperative, has an affiliate, the Staple Cotton Discount corporation, which finances production expenses of members and obtains funds by rediscounting members' notes with a federal intermediate credit bank.

These arrangements also have most of the earmarks of merchant credit. Financing is furnished primarily to increase or hold sales and to maintain other business relations. In some instances the obligation will carry a specified rate of interest. In other instances the interest charge consists of a higher price charged for feed, fertilizer or some other hidden form.

When the contractor furnishes credit to growers, he in turn will need larger amounts of capital. In most cases these additional capital requirement will be provided by loans from a commercial bank or he will utilize other means of financing accounts receivable which have developed in commercial financing.<sup>3</sup>

In the types of financing just discussed, the advances made involve definite creditor risks to the contractor while the growers assume definite debtor obligations. The grower usually has considerable business risk also since he is buying supplies for a stated price with the expectation

<sup>&</sup>lt;sup>a</sup> See for example Clyde William Phelps "Accounts Receivable Financing as a Method of Business Finance," Studies in Commercial Financing No. 2, Commercial Credit Company, Baltimore, 1957.

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that the finished product can be sold for enough to cover the cost of supplies, including the debt, and leave some margin for profit. It seems reasonable to conclude, however, that the business and credit risks involved in these transactions are somewhat less than in many other types of farming operations because the growers have contracts which assure some measure of market protection or stability. These contracts either provide an assured outlet or a premium over current market prices or in other ways reduce the market uncertainties.

A different combination of business and credit risks ocurs in the type of integration and contract arrangements which have been developed in the broiler industry and are now spreading in other types of poultry and livestock production. Under this form of contract, the grower does not take or hold title to the chicks, poults, pigs or cattle which are being grown or fattened. The contractor retains title and as he furnishes feed, medication and possibly other supplies, the growing broilers or other livestock represent an asset of the contractor increasing in value. The grower on the other hand furnishes the plant where the poultry or livestock is housed and produced, the labor, and possibly other minor items in the production process.<sup>4</sup>

In other cases there are arrangements where the contractor leases pullets or gilts to the grower. Here again the contractor retains title under certain conditions specified in the contract.<sup>5</sup>

In these instances where title is held by the contractor, the advances which he makes actually do not constitute credit and therefore cannot properly be carried as accounts receivable. They are investments or perhaps more accurately "goods in process of manufacture." While the assets are on the property of the grower, he does not assume any responsibility as a debtor. He is more in the nature of a custodian of the livestock, feed and other supplies which are turned over to him. The contractor, of course, assumes risk in making these outlays but it is a business risk and not a credit risk.

While such outlays are not credit transactions, they constitute nevertheless a device for making capital available to the grower to use in a business operation and which enables him to increase the size of his operation and thereby his income. In this respect they perform a function similar to that of credit. There is another feature that gives such transactions some similarity to merchant credit. They are designed to attract customers or establish business connections.

<sup>&</sup>lt;sup>4</sup>With respect to broiler financing, see "A Summary of Selected Recent Studies on Broiler Financing and Contracting," Agricultural Marketing Service, USDA, AMS-183, June, 1957.

Note, for example, George Gates, "Foxbilt Swine Lease Program Gives Feed Volume Big Boost," Feedstuffs, March 28, 1958.

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Under this type of operation, as in the case of the previous class, the contractor performs the function of mobilizing a major portion of the capital needed in production. He furnishes a good part of the capital needed by the individual grower as well as that needed in his own processing and other operations. Some of this will come from his own funds but usually he will need business loans which will be obtained from the larger commercial banks or through other established financing channels.

#### Implications and Economic Considerations

In considering and appraising the credit aspects of vertical integration which have just been discussed, a number of significant points or implications can be identified.

1. One result of vertical integration has been to enlarge the number of farmers who can be or are being financed. Many farmers who previously had little or no basis for credit have been able to develop a new enterprise or expand one that was on a precarious basis, thus adding to their incomes. In the broiler industry particularly, banks and production credit associations had been reluctant to finance many individual growers partly because they were financially weak but mainly because of what appeared to be high risks in an industry subject to wide price fluctuations and an uncertain future.

A contractor, however, can and does finance such producers with less risk because through his contract he has more effective control over the producer than has a specialized lender. His professionally trained fieldmen instruct the grower in approved methods of production, check to see that instructions are carried out and that everything is being done satisfactorily and make other important decisions. In addition, the contractor controls the marketing of the product and thus can be assured that the proceeds are promptly applied on the related credit or investment. It is in effect supervised credit in a highly developed form with considerably reduced risks.

2. In cases where growers are being financed and supervised by contractors, standards of credit acceptability are being revised. In selecting growers for financing and production contracts, the prime consideration is coming to be the skill and ability to turn out the quality and type of product specified and required by the contractor. In addition to technical competence and general dependability, the grower also may have to provide the land, buildings or equipment necessary for such production. Net worth and general financial condition, which usually are high among credit factors, tend to receive less emphasis since close supervision and rigid control by the contractor reduce the risks normally connected with this credit factor.

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and vith 3. Some shifts in sources of credit are occurring in areas or industries where such financing by contractors is well advanced. Some accounts representing the financing of production expenses are being lost by production credit associations and smaller country banks. Such financing is being furnished instead by contractors who in turn obtain their credit needs from larger or city banks. If the contractor is a cooperative, the shift may be to a bank for cooperatives.

Such shifts are already well advanced in the broiler industry. They also have occurred in some degree where dealers and other middlemen sell on credit generally. Dealers and cooperatives selling on credit are likely, in turn, to seek their financing from the larger banks or banks for cooperatives. There may be even further links in this chain as where, for example, feed dealers who finance farmers are financed by the feed manufacturer who, in turn, is financed by a bank or other specialized financing institution. The extent to which such shifts in sources of financing are likely to ocur cannot now be estimated. There may be offsetting trends as suggested in the next two points.

4. The shifting of financing for operating expenses away from production credit associations and rural banks to larger city banks is not necessarily inevitable. It is doubtful if many contractors actually want to be in the financing business and it is probably true also that many contractors who are financing growers would be willing to cooperate in working out a transfer of the financing function to a specialized lender. Furthermore, as producers accumulate financial strength and technical know-how and establish good market connections, they may desire greater independence and want to arrange their own financing. It seems probable also that banks and production credit associations in the future are likely to be more willing to finance growers who are under contract and have the benefit of the supervision and market outlets than they were when growers were operating more independently and carrying more of the risk themselves. Perhaps a more likely possibility is the working out of financial arrangements like those being developed between production credit associations and cooperatives in the St. Paul Farm Credit district.

5. Production credit associations, commercial banks, federal land banks, insurance companies and some other lenders undoubtedly can obtain considerable loan business in financing the capital needs of growers under contract. Specification production, which usually characterizes vertical integration, normally calls for specialized buildings and equipment. This is particularly true in contract production of broilers, eggs, hogs, and cattle. Many of these contracts involve carefully drawn plans for the type of plant and equipment to be used.

Contractors may, but usually do not, finance such capital requirements.

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Production credit associations and banks instead are furnishing much of the intermediate and longer term credit needed. This is a potential field for federal land banks and other long-term lenders particularly, since the main collateral is likely to be a real estate mortgage. Such loans, moreover, will have some safeguards in that the operators will have the advantages of definite market outlets and supervision provided under the contracts.

6. Cooperatives have a potentially large role to play in vertical integration. If they can provide the required credit and related services, they will be able to capture for farmers a substantial share of the economies that are possible in vertical integration. In such a program, cooperatives will need large amounts of capital and credit to finance plant expansion and to cover the financing of supply sales to members under contract. To the extent that such credit is obtained from banks for cooperatives, the latter will have not only an opportunity to build loan volume but also to take a constructive part in a program that has great potentialities for making savings for farmers.

7. If cooperatives are to enlarge their role in integration and agribusiness generally, it may be necessary for some of them to revise their policies and practices in financing sales, including particularly sales to farmers under contract. Experience shows that a basic requirement in most grower-processor contractual arrangements is that the grower must be adequately financed. The trends clearly suggest that many if not most growers

will look to the contractor for financing assistance.

Cooperatives, therefore, will likely have to give increased attention to financing sales to patrons. If a cooperative cannot work out arrangements through affiliated credit corporations or credit unions or through production credit associations or banks which are satisfactory to both the association and the farmers, then it may have to undertake a sound program of furnishing credit itself. This in effect will be an additional service which the cooperative will furnish. Like any other department, it should be in charge of an expert with the credit phases supervised by an experienced credit man. Where the volume is insufficient to justify a full-time credit manager, he may be employed on a consulting basis. Such adaptations to current trends must be recognized by both cooperatives and the banks for cooperatives which will be called on to do a substantial part of the underlying financing.

8. Although some lenders are losing business as a result of the shifts in financing previously mentioned, one net result of vertical integration has been to attract capital into agricultural industry. From some viewpoints this may not appear desirable because of the danger of producing surpluses. But the grower-processor contracts and financing in the broiler

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industry, for example, undoubtedly have drawn in capital from large city banks and the banks for cooperatives at a rate that would not have been possible if each grower were left to find his own financing. As far as the current record shows, such loans appear to have been good risks. The experience suggests that the integration of growers and processors will be helpful in attracting capital to types of farming where risks in financing individual growers previously had been relatively high.

9. A final point is that the role of credit and lenders is becoming more important as vertical integration develops. In building vertical chains, additional capital is usually required at nearly every step in both the production and marketing stages. This places the lenders in strategic positions to influence operations and policies. By the same token, it puts a great deal of responsibility for success or failure on those furnishing credit. While it has always been important for lenders to study the operations financed, it is particularly necessary for them to keep abreast of new ideas and methods which are basic to the industries being integrated and financed. If they do not keep fully informed, lenders are less likely to measure up to these added responsibilities.

## DISCUSSION: CREDIT IMPLICATIONS OF INTEGRATION IN AGRICULTURE

IVY W. DUGGAN
Trust Company of Georgia Associates

Webster's dictionary defines vertical combination as a combination or amalgamation of concerns engaged in different stages of manufacture or distribution of a product in its conversion from raw to finished material. Vertical integration is not new in agriculture. It is as old as indigo and rice production in South Carolina and as new as cotton production in California, or broiler production in Georgia.

Vertical integration was developed rapidly in the South following the Civil War. The land holder had only his land; the slaves had only their labor and neither had capital. The larger plantations were financed by factors or cotton merchants and the small farms by the local merchant. The suppliers of credit assumed some rather large credit risks and received high returns on the credit extended. Many of the management decisions were made by the suppliers of the credit.

Most lending institutions are not in a position to supply management along with credit. In his speech on integration in the livestock industry Engleman said that integration directly and primarily affects the decision-making function of management. It has been defined as "control by one

management." Note that the word is control, not ownership, by one management. The general economists and, up to the last year or so, the agricultural marketing economists, have usually thought of corporate mergers as the primary examples of integration—either vertical or horizontal. Wherever there is a separation of control and ownership there are additional

credit problems.

Cornell University made a study of some dairy farms in New York state which points out the importance of capital changes in agriculture and also indicates why vertical integration is taking place. Their study shows that in 1947 the capital used on these farms was about 3½ times as large as in 1907. Farm receipts were up too. In 1947 they stood at 8½ times the amount of 1907. But production expenses were 14 times as high. The report on the study points out that in 1907 it took 9.7 years for a farmer's expenses to equal his capital investment. In 1947 it would take only 2.5 years. Therefore, in 1907 if a farmer ran into a period of low prices or poor crops it would be 9.7 years before his expenses equaled his capital investment. By 1947 his expenses would have equaled his investment in 2½ years.

The report goes on to say that "a falling price level could wreck the modern farmer, but not so much because of debts as because of high and relatively fixed expenses for equipment, gasoline, fertilizer, insurance, electricity and the like. Farming has always been a gamble. The stakes are

much higher now than 40 years ago."

Technological progress in agriculture, greater standardization of agricultural products and rigid cost structures and overexpansion of the agricultural plant have all contributed to vertical integration. However, it would not seem from evidence to date that vertical integration will lessen the tendency for production to outrun demand. It may intensify

this problem.

Financial institutions extending credit to agriculture are interested in the degree and kind of integration. Where there is complete vertical integration through ownership it is relatively simple to determine who will get the credit and the amount and terms of credit to be extended. Where there is complete integration by means of contract, the problems—who will get the credit, the amount of credit and the terms are not too difficult.

Where there is only partial integration through ownership, or by means of contract, the problems of who will get the credit and the amount and terms of credit to be extended become much more involved.

Financial institutions are not in the business of supplying equity or risk capital for business or for farming. These institutions make loans

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based primarily on the worth of the borrower, his liquidity, and the borrower's repayment ability. Furthermore, the narrow margins between the cost of money to the lender and interest rates charged by banks, production credit associations and other institutional lenders are so low as to preclude any extensive risk-bearing by these lenders. To the degree that lending institutions increase their risks they must increase their interest rates.

Engberg's paper is very good on the whole. However, I would like to comment on certain parts. He states, "to a considerable degree the credit phases are similar to and have about the same problems as merchant credit." I would say that there are many more differences than similarities.

Engberg, no doubt, is well aware of the usual high charges of financing automobiles through automobile financing companies, and of the unsound practices that have developed in automobile financing over the years. I do not think he means to recommend this type of financing for agriculture.

In discussing the role of cooperatives and production credit associations in financing vertical integrated agriculture, Engberg does not give sufficient attention to management control and ownership by the cooperative or production credit association. The Central Carolina Farmers Exchange<sup>1</sup> and the Georgia Cotton Producers association have both had to meet these two problems "head on" in financing broiler production.

Engberg states that where growers are being financed and supervised by contractors, standards of credit acceptability are being revised.

These standards are not being revised, rather the credit risks are being shifted, to a degree, from the grower to the contractor.

It is not necessary for small country banks to be "squeezed out" of the agricultural credit field because of integration. A country bank should be able to extend credit to integrated agriculture, provided the country bank has a correspondent city bank that understands agricultural lending and is interested in making loans to agriculture.

I agree with Engberg in his view that cooperatives and production credit associations can materially assist in financing integrated agriculture. However, to the degree that they assume increased risks they will gain more control of management decisions and even ownership, and farmers will retain less control and ownership of the products produced and will carry little of the production credit risks. Cooperatives and production credit associations will have to increase their charges to cover

<sup>&</sup>lt;sup>1</sup>See Abrahamsen and Engberg, "Integrated and Related Operations—Central Carolina Farmers' Exchange," Farmer Cooperative Service, USDA, General Report 44.

the increased risks and services. They will also likely have to increase their capital.

Cooperatives and production credit associations must move with caution and soundly appraise their risks or they will impair their own credit rating and their ability to secure funds for their operations. It is a new field to them and one they must explore thoroughly.

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### TENURE INNOVATIONS AND TENURE PROBLEMS ASSOCIATED WITH VERTICAL INTEGRATION

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RAYMOND J. PENN University of Wisconsin

VERTICAL integration was once a scientific term in the economics profession used most often in analyzing the structure of large industrial organizations. In the last few years, however, vertical integration has become a commonplace term in agriculture. Professional agricultural economists are giving substantially more attention to the subject. Farmers are concerned about vertical integration and their farm organizations headline it at farm meetings. Stories about "vertical integration," "contract farming," agribusiness," or "package deals," rate high in news value.

The subject assigned me suggests that vertical integration in agriculture has caused some tenure problems and that we should explore available tenure innovations which may resolve these issues. To treat this subject I propose to (1) comment on vertical integration, per se; (2) demonstrate the need for tenure ideas in understanding, analyzing, and resolving problems created by vertical integration; and (3) delineate some of the tenure problems associated with rapid expansion of vertical integration. You will not be surprised to find the "tenure" aspects of the subject given a strong "land" flavor in view of my experience in land economics. As a matter of fact, vertical integration in my filing system has been given a place under the general heading of land tenure. However, I suspect some tenure ideas and innovations important to the question here discussed may well come from labor's collective bargaining experience or the university professor's quest for tenure and academic freedom.

### Vertical Integration

There is rather general agreement on the precise scientific definition of "vertical integration." Mueller and Collins say: "The term vertical integration is generally used to indicate the coordination of decision-making processes of two or more stages of production."

In another place Mueller says: "Vertical integration refers to the linking together of two or more stages of production or marketing."<sup>2</sup>

Scoville says: "... vertical integration ... may be broadly defined as the coordination of the management decisions made in two or more of

Economic Information for Wisconsin Farmers, August, 1958.

<sup>&</sup>lt;sup>1</sup>W. F. Mueller, and Norman R. Collins, "Grower-Processor Integration in Fruit and Vegetable Marketing," *Journal of Farm Economics*, December, 1957, p. 1471.

<sup>2</sup>W. F. Mueller, "What Vertical Integration Can Mean to Wisconsin Farmers,"

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the different stages of the chain of production, processing, and marketing actions. Coordination here means something more personal and direct than the influences of the price mechanism and the marketplace."<sup>3</sup>

Abrahamsen says: "Vertical integration . . . means taking one or more products through more than one stage in marketing or buying."

Although we have this agreement that vertical integration means coordination of management functions at successive stages, some confusion develops if we do not go further and specify just how such is achieved. We sometimes forget that there are other effective ways to link production stages.

Production, processing, and marketing is, and always has been, an integrated process. In a subsistence agriculture vertical integration is very nearly complete since most of the production resources and most decisions as to production and consumption are in the same hands.

But as we acquire new technology and capital so that the production process can be "round about," specialization and division of labor takes place. The result could be a "disintegration" of the production process. Instead, three kinds of conditions can be employed to maintain integration.

1. According to our traditional economic models, market price can coordinate management decisions at different stages of production, processing, and marketing. Mueller points out that in theory, price would integrate the activities of buyers and sellers perfectly. However, in practice buyers and sellers often are not satisfied with the functioning of the price system and they seek more direct ways to achieve coordination or vertical integration.

2. Another very effective method of integrating two stages of production, even in a highly developed agriculture, is to have ownership, and therefore the power of decision-making, in a single set of hands regardless of who actually performs the production function.

3. A third method of coordination, and the one probably at the root of most of our concern about vertical integration, is the use of contracts or agreements to transfer certain management responsibilities from one stage of the production process to another regardless of who actually owns the resources used at that stage. When this method is used, ownership of resources does not give the same control over management decisions or the same access to agricultural employment that it once did.

So, it seems to me, the central question is not what vertical integration

<sup>&</sup>lt;sup>8</sup> O. J. Scoville, "Where to in Agriculture-Business Integration," paper given at the annual meeting of the Association of Southern Agricultural Workers, Little Rock, February 3, 1958.

Martin Abrahamsen, "Business Integration—What it Means to Cooperatives," News for Farmer Cooperatives, Farmer Cooperative Service, USDA, November, 1957.

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is-somehow all stages of production must be integrated—but rather how it is achieved.

Mueller has just authored a publication on vertical integration with which I am in substantial agreement. Hence, there is no need for extended discussion of the subject. However, there are several ideas commonly overlooked that need re-emphasis.

1. Vertical integration is often wrongly considered as automatically conferring market power, enabling a firm to get big and to become one of the few in the market. This is something farm people are worried about, unless, of course, the firm involved is a farmer cooperative or is considered part of a farmers' "self-help" program.

The definition of vertical integration as a scientific term says nothing about increasing the size of the firm, creating market power, or establishing a monopoly. The subsistence farm of the frontier days combined very low volume and very weak market power with an almost completely vertically integrated organization. Market power grows out of integration horizontally, out of being one of few in the market, out of being big. It is true, however, that as a present-day firm adjusts to new situations it is likely to integrate both horizontally and vertically. Furthermore, a change to a more vertically integrated operation requires a greater accumulation of technology and capital. The resulting new operation, because it is in fact bigger, thus has more market power than the old. Hence, there is some reason for the confusion when the concept becomes commonly used in a nonprofessional way.

2. Technological change does not automatically and with certainty result in a change to new and more rigid integration devices. I suspect many farm people, fully aware of the rapid technological changes since 1950, fear that Dean Butz of Purdue is right when he says that technological innovations require so much capital and management skill that the "commercial farm will increasingly assume the characteristics of a manufacturing establishment. In these farm units the manager will spend much of his time and energy assembling 'packages of technology' which have been produced by others on a custom basis."<sup>5</sup>

Actually technological change does not inevitably put management decisions into fewer hands. It can have a variety of effects—some of them conflicting—on the production and marketing process.

As previously noted, technological change was what first permitted division of labor and dispersion of decision control over production units. The result was an increase in total production.

Even today changes such as hybrid corn or artificial insemination tend

<sup>&</sup>lt;sup>5</sup> Earl L. Butz, "The Agricultural Dilemma," Agricultural Leaders Digest, June,

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to put control of management decisions into more, not fewer, hands. They do not encourage a new type of integrated operation.

On the other hand, there are technological changes that make it desirable or even necessary to integrate certain physical processes of production, and therefore tend to centralize the decision-making function.

What happens most often is that technological changes disrupt the market mechanism to the point where individual firms attempt to integrate around the market. When a change increases capital requirements and the capital market is not available to the established firms, the supplier of capital may insist on a shift in ownership or management of resources. When a change requires increased skill or ability not currently possessed by the farmer, a shift in ownership or management of resources may be necessary until these skills are acquired.

So technological change has an impact on vertical integration, but its greatest influence results from the fact that the market mechanism often is not able to keep pace with the changed technology.

In agriculture, as in modern industry, market considerations are probably much more important forces for vertical integration than technological factors. Scoville lists eight main forces responsible for the growth of agriculture-business integration. Six are mainly market considerations and two primarily technological. They are, in summarized form:

- 1. The need for adequate and stable supplies.
- 2. The need for continuous supplies.
- 3. The need for better supplies.
- 4. Efforts of farmers to spread and reduce risk.
- 5. Efforts of farmers to improve prices or create a market.
- 6. Efforts of farmers to reduce costs.
- 7. Efforts of farm suppliers to expand the market for farm supplies.
- 8. Efforts of either farmers or business firms to improve efficiency of resources used in farm production.<sup>6</sup>

Much of the anxiety about vertical integration disappears when we realize that farming is not necessarily on a one-way street from new technology to new devices for integration. Several things can be done to reduce the need for new forms of vertical integration. For instance, Mueller asks:

"1. How well are our private and public credit agencies satisfying farmers' needs? If these agencies can do the job, farmers need rely less on suppliers or buyers for credit.

"2. How well are our extension workers, county agents, and others doing in helping farmers keep up with technological change or changes in market de-

<sup>6</sup> Scoville, op. cit.

mand? Good farm managers don't need much production advice from suppliers or buyers, and are better able to supply what buyers want.

"3. Have we done everything we can to make the price system work? Often establishment and use of better grades are effective in getting farmers to supply the proper products. Let's not give up the market system unnecessarily. "4. How prosperous are farmers? Financially poor farmers are most suscepti-

ble to integration deals.

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"5. How well are our cooperatives doing their jobs? Farmers can do the integration job themselves if there are sound economic reasons for integration and if their cooperatives are properly organized to do the job."

When the answers to these questions are favorable from the farmers' point of view, not only can we expect some slow down of the process and a shift of management decisions back to the farmer—we can also expect a reduction in the tension or concern farmers feel about the integrated relationships that remain. Integration can be done by choice, it does not need to be done out of hopelessness or despair.

# Tenure Ideas Important to Vertical Integration

Tenure means to own and to control. Land tenure means to hold or to control land. Land ownership is the central subject matter. This includes the process by which a person acquires rights to land, whether by fee simple ownership, mortgage, contract for deed, cash or share lease, or just plain adverse possession or rights to the public domain acquired by prior use. It includes the limitations placed on those rights by the public through police power, taxation, eminent domain, and spending power. It includes the processes of group planning and bargaining since sometimes it is desirable to modify the rules governing the rights to use land. It includes the administration of public lands as well as the public interest in private lands.

It is no accident that land ownership and land tenure have been given special attention. Ownership or control of land gives a person the right to use the land, the right to his home, his place of business, to his farm. Control of land is a person's access route to farming. And in addition land has been the farm family's means of old age security (a hope not always realized).

Adam Smith and Marshall did not intend to neglect property and the monopoly aspects of land ownership. However, in order to simplify their economic model, all property, as well as all other institutions, were assumed to remain in the status quo. The real damage of this assumption has come in the last 15 years with the elaborate refinement of the profit

<sup>&</sup>lt;sup>1</sup>W. F. Mueller, "The Economics of Vertical Integration," speech given before the Workshop for Cooperative Specialists at the 30th Annual Meeting of the American Institute of Cooperation, Pennsylvania State University, August 22, 1958.

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maximizing model. When the matter of land ownership is not neglected altogether, it is treated as an "obstacle" to the "most economic allocation of resources." And research to aid in removing the obstacle, if considered at all, is designed to determine how much mal-allocation of resources results from it. If a lot, then the change will be forthcoming. It shouldn't be too difficult to see that if what is needed is to change certain land ownership laws, one should study the process of changing those laws and what changes in the laws would mean in terms of economic opportunity of persons affected.

Land tenure has been concerned with the many facets of land ownership because control of the land resource was the access to farming (as well as other land uses). The "land ownership ladder" or the process of acquiring ownership to land has been one area of land tenure study. Another has been the reasons why farm owner-operatorship has been a rather constant goal of farm people and of farm policy. Land tenure specialists have documented the fact that the importance of land ownership grows out of the fact that it gives access to employment and more alternatives to the farm family. Land tenure specialists have also documented the fact that land ownership in some situations does not increase real opportunities for employment alternatives, when, for instance, the farm is too small for any kind of profiitable operation or a drought limits farm production.

Some of the recent trends in vertical integration are reducing the importance of land ownership as a means of access to farming. Land ownership may not change but some of the management decisions move away from the farmer. The shift of management decisions carries with it control of employment opportunities. The problem then shifts some from control of land to control of the strategic factor in the integration process. Experience of the land tenure specialist in studying ownership and control of land will furnish significant guides to studying the strategic factors controlling the integration process.

It is my firm conviction that these land tenure ideas, subject matter, and methods must be incorporated in our economic analyses if we are to

even understand integration, to say nothing of doing something about it.

# Tenure Problems Associated with Vertical Integration

By now some of the things I consider tenure problems should be apparent as well as some of the ideas or innovations to relieve the problem.

1. Farm people fear that each change in technology will result in more vertical integration shifting some of the management decisions from them. Actually this may not be as much of a problem as farm people think it is since some changes in technology can discourage the shift as well as encourage it. And besides, the shift can be discouraged or in some cases

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reversed if we take aggressive steps to do such things as make adequate credit available, rapidly disseminate knowledge about the new technology, and to make market pricing a more effective guide to resource allocation.

2. Vertical integration stands as a threat to the family farm in the minds of many farm people, probably because vertical integration has flourished in areas of small farms with low incomes. The real problem here is one of adjusting the individual family farm fast enough in size, capital requirements, and techniques so that the farm family can farm as well as possible and their income will be comparable with others in our economy. This adjustment is not a simple one, but if it can be made then vertical integration will probably not present a major threat to the family farm.

3. In some areas when vertical integration has shifted the management decisions from the farmer, it may be desirable for farmers to organize their own management firm. And we may actually see some increase in collective bargaining groups in agriculture.

4. It is quite a commonly held view that vertical integration can stabilize or increase farm prices. This, of course, is not true. The reason farm prices are unstable and often low is that we now have the technology in agriculture to produce more than can be sold at a reasonable price. In this respect we are like any other industry. But unlike them we have not worked out satisfactory ways of gearing agricultural production to demand. The point is that even where vertical integration has been associated with horizontal integration there has not been enough market power in any one enterprise to control production and price. Firms may be larger, but the only real increase in power they gain is the power to compete more fiercely price-wise. This has happened in the broiler enterprise.

5. I list as a problem the need for research on how vertical integration is accomplished. Much of the research to date has dealt with efficiencies of scale. This, of course, is important. However, it is probably true in agriculture as it is in the nonagricultural segments of our economy that the major reasons for integration and mergers are not to be found in greater efficiency of larger units or integrated units. We will need to expand our research into such areas as: (1) the types of situations conducive to integration, (2) the methods including contracts used by integrators to gain control of the management decisions, (3) the effect of the shift in management decisions on the opportunities of the family, (4) the effect of vertical integration on farmers' income and the prices of farm products, (5) types of action might be used to carry out group policies with respect to vertical integration. Economists working in land tenure, cooperative marketing, or those otherwise considered institutional economists, will have a major role in this type of research.

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Vertical integration is not an irrevocable one-way street leading only to bigness. If we are not to be frightened by vertical integration we must understand it, use it where it expands our opportunities, and stand ready to discourage it when necessary. And we can discourage it if adequate credit is available, if farmers can keep up with technological change and changes in market demand, if farmers are prosperous, if the price system works, and if cooperatives are doing their job.

# DISCUSSION: TENURE INNOVATIONS AND TENURE PROBLEMS ASSOCIATED WITH VERTICAL INTEGRATION

Marshall Harris\*
University of Iowa

I am in full accord with Penn that (1) vertical integration in my file is under the general heading of land tenure, (2) the important tenure problem is how coordination of the management function is achieved, (3) power in the market place is largely the result of horizontal integration in contrast with vertical integration, (4) technological change would not result in vertical integration if the economic system, particularly the market mechanism, were functioning smoothly, (5) efficiency-oriented economic analysis usually tends either to assume ownership and control as given or to treat them as obstacles to the most economic allocation of resources, and (6) areas of research should include how vertical integration is accomplished and how the shift in management decisions affects farming opportunities and prices.

I am not in full agreement with his interpretation of our assignment, reasoning from problems to innovations. Rather, I should like to reason from innovations to problems. The solution of problems should come only after intensive research, not before the problems are defined and analyzed.

Anxiety does not disappear when we outline some things that we might do which are not conducive to new forms of vertical integration; specifically, improving public and private credit, helping farmers keep up with technology and markets, endeavoring to make the price system work, and improving farmer cooperatives. This merely shifts anxiety from vertical integration to imperfections in present functioning of our economic system.

Opinions expressed in this paper are those of the author and do not necessarily represent those of the Farm Economics Research Division, Agricultural Research Service or the USDA.

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sarily earch The implication that there is adequate agreement on what is meant by vertical integration may be misleading. If one accepts the idea of agricultural integration as the coordination of management decisions made in two or more steps in production and distribution, then the concept is so vague, nebulous, and complex that it can be discussed only in the most general terms. This is the tangled web in which Penn became enmeshed in his paper; and I might say, he has plenty of company. This is indicative of the present state of our knowledge of vertical integration in agricultural production.

Before we can communicate with incisiveness, we must be able to talk about a particular type or class of vertical integration. If vertical integration, as suggested in recent literature, may involve merely the combining of stages of production on the farm, as the addition of a beef enterprise to consume farm-raised feed, then we do not recognize either a tenure innovation or a tenure problem. If it is best exemplified by contract farming in broiler production, then vertical integration carries many tenure implications.

We will remain confused so long as vertical integration encompasses in an undifferentiated sort of way, even as a Mother Hubbard, subsistence farming, agribusiness, business-farmer contracts, marketing agreements and orders, price support programs, business-owned farms, farmer cooperatives, vertical diversification, and off-farm integration of processing and distributing. We can neither visualize nor analyze integration ranging all the way from a Crusoe subsistence economy to a chain store that engages in the entire production and distribution process from artificial insemination to selling the product ready for the frying pan. Classification for effective communication and scientific analysis is relatively untouched. Obviously, this is much too large a job to undertake today.

A few tenure innovations may be summarized as follows:

(1). Neither ownership nor operatorship carries the traditional connotation of control, whenever business management decisions are shifted from the farm operator. Where the contracting farmer has become a piece-rate worker, his role as an operator has largely disappeared. He is essentially a laborer working for wages, under the direction of the integrator. The shift from an independent operator to a managed laborer is a tenure innovation.

(2). To the extent that management decisions are shifted from the farmer the basic characteristic of the family farm—whether owned or rented—has largely disappeared. The family farming concept is meaningless if it does not hold that management decisions must be largely in the hands of the farm operator. A tenure innovation is the managementless class of owner-laborers,

(3). Another tenure innovation is the introduction of privately supervised credit. This usually results whenever credit is an essential part of the integration.

(4). Vertical integration introduces a new hyphenated firm as a unit of observation. The result may be the same whether the new firm is called agribusiness, integrator-farmer, supplier-producer, or other variations. If vertical integration makes deep inroads in the total business management of the firm, then a new economic model may be needed for analyzing tenure innovations and problems.

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(5). An operator of a highly integrated farm divests himself, to a large extent, of making management decisions and bearing risks. Ownership and operatorship, key tenure concepts, may take on entirely different meanings. We will need to distinguish the integrated owner or operator from his nonintegrated distant cousin. From the standpoint of management and risk, the new tenure status may be dubbed "disintegrated" owner or operator. For, in fact, these tenure statuses, as we know them, will have disintegrated, in whole or in part.

The tenure-oriented *problems* that emerge with vertical integration have been foreshadowed by the *innovations*. Among them are:

(1). A basic tenure problem is that of how management and control are shared in the new hyphenated business-farm firm. How will they be arranged under a tenure system and among a people characterized by independent decision and freedom of action? What are the likely ultimate results of this hybridization?

(2). Another tenure problem is the security, time-wise, of the agreement under vertical integration. For how long a term are the parties committed? What is the new planning horizon? What is its impact? What will be the situation when the relationship ends?

(3). When vertical integration is used to secure assistance in management to obtain technical competence, to acquire needed credit, to assemble equipment, housing and feed, to alleviate risks—both price and physical—and to assure at least a minimum level of earning, the problem arises as to what tenure rights, in addition to management and control, will the farmer give up in exchange for these so-called advantages? How will this affect his farm as security for old age? What effect will it have upon the inheritance process? What effect will it have upon his position in the real estate credit market?

(4). The complexity of the integrator-farmer relationship is multiplied on rented farms. What new renting problems will arise? What will be the impact upon the already complex human relations on the share-rented farm? What will the operator's tenure rights look like after they are divided with both integrator and landlord?

# FARMERS' DECISIONS ON NEW PRACTICES

Chairman: Charles H. Merchant, University of Maine

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#### NEW KNOWLEDGE OF DECISION-MAKING PROCESSES

GLENN JOHNSON\*
Michigan State University

THE TITLE of this paper calls for new knowledge about the decision-making processes. At last year's meeting of the association, at least two papers were presented dealing with new theoretical knowledge concerning the decision-making process.¹ In view of this it appears I should concentrate upon new empirical knowledge.

The Interstate Managerial Survey (IMS)<sup>2</sup> has produced a substantial amount of empirical data on many aspects of the decision process. These data are available for all or part of 1075 farmers located in eight strata in seven midwestern states.

I will concentrate upon only a part of these data—more specifically the data on types and sources of information which farmers use in their decision processes, the importance they attach to different kinds of information and the difficulty they experience in getting kinds of information.<sup>3</sup>

Finally, I will examine the information content of agricultural college

<sup>&</sup>lt;sup>e</sup> Cecil Haver, University of Chicago, is co-author of a bulletin manuscript reporting the information contained herein in much more detail.

Glenn L. Johnson, "Methodology for Studying Decision Making," Journal of Farm Economics, December, 1957, p. 1215f and Clifford Hildreth, "Problems of Uncertainty in Farm Planning," Journal of Farm Economics, December, 1957, p. 1430f.

<sup>&</sup>lt;sup>2</sup> For more information about the IMS see *Journal of Farm Economics*, December, 1955, pp. 1097-1125. As this paper covers only a small fraction of the data produced by the IMS, it is not properly a basis for appraising that study in its entirety.

<sup>&#</sup>x27;s The following will help the reader evaluate the probability of interviewer bias in some of the data presented in this paper.

Fifty-six X² tests were run for the presence of significance differences among answers recorded by interviewers gathering data on sources of information used by farmers in the same stratum. Six of the 56 tests revealed differences larger than those used by those expected as a matter of chance 1 per cent of the time. Inasmuch as sources of information used are related to certain variables not necessarily randomly distributed geographically and inasmuch as sample segments were not assigned to interviewers at random this number of significant differences does not appear very damaging.

Eighty-eight X<sup>2</sup> tests of significance were run for the presence of significant differences among answers recorded by different interviewers collecting information, in the same stratum, on the characteristics of the farms and managers involved. Ten of the 88 tests reveal greater differences than expected in 5 per cent of such tests. Again nonrandom assignment of interviewers to segments may account for some of the significant differences found.

In any event, the number of cases showing significant differences is relatively small. Corresponding tests for interviewer bias have not been run on answers to other questions used herein.

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publications so as to reach some conclusions about the role agricultural colleges are playing and can play in servicing farm managers who have many decisions to make in the rapidly changing scientific and technological world of the present and near future.

### Kinds of Information Farmers Would Use in Organizing and Operating Farms

The information patterns which farmers say they would use in organizing and operating farms are indicative of the broad general nature of farmer demand for information. The IMS furnishes us with some indication of these information patterns in eight selected areas located in seven midwestern states.<sup>4</sup>

Table 1 indicates that production (old technological) information and information on new technologies are the predominant types that farmers would use in organizing and operating farms for profit. Over 50 per cent of the times farmers mentioned the broad categories, they mentioned one of these two types. Farmers mentioned the need for information on new production technologies more often when considering the operation of farms for profit than when considering farm organization. In considering the operation of farms to maximize family satisfaction, farmers paid relatively more attention to information on institutions and home technology (both new and old).

## Relative Importance of Different Kinds of Information to Selected Groups of Midwestern Farmers in 1954

The relative number of times farmers would use different kinds of information does not necessarily indicate the relative importance of the different kinds of information to farmers—for instance, one need use information which saves his life but once for it to be important to him. To check this, farmers were asked to rank five types of information according to relative importance to them. The five types included information on prices, production methods, new technology, humans and institutions. Flash cards describing and giving examples of the five broad types of information were given to each respondent. These cards, which will be printed in more detail in later reports, have already been distributed to many in the profession. As farmers were asked to give these ranks for "setting up and operating farms to get the most out of life" and "for profit", the

<sup>&</sup>lt;sup>4</sup> North Dakota, Iowa, Kansas, Kentucky, Ohio, Indiana, and Michigan. Methods of coding and processing are discussed in a Michigan Agricultural Experiment Station publication now in process of clearance and publication. The kinds of information farmers would use were classified into over 200 categories which were classified into 42 subcategories and finally into the six major categories.

Table 1. Number of Times Components<sup>a</sup> of the Six Major Types of Information Were Mentioned by Selected Groups of Midwestern Farmers in 1954

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Type of Information	0		Operating Farms For					
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	Number		Number		Number	Per cent		
Price	46	1.6	919	7.0	89	5.6		
Production Method	1565	53.0	1562	44.1	230	14.4		
New Production Technology	4	.1	642	18.1	103	6.4		
Human	455	15.4	50	1.4	255	16.0		
Institutional	871	29.5	322	9.1	804	50.3		
Home Technology	11	.4	45	1.3	117	7.3		
Total	2952	100	3540	100	1598	100		
Number of Farmers Interviewed	534	_	903		903			

<sup>a</sup> Excludes mentions of the six broad types—only mentions of component category are tabulated Chi-square=3269 with 18.3 required at the 1 per cent level.

total ranking apply to an average, of sorts, of the situations to which the three columns in Table 1 apply.

On an over-all basis, the rankings show price information to be relatively more important than indicated by the relative number of times farmers indicated they would use price information.

However, we cannot overlook the fact that production methods (old technology) and new technology jointly accounted for a high proportion of the "most important" rankings. Clearly, technological information would be a widely if not the most widely used type of information for the farmers interviewed.

Information on new technology has a different pattern of importance than information on existing production information. It was ranked of first importance in only 64 out of 920 rankings and least important in 216 out of the same number of rankings.

# Sources of Information Used by Farmers

The IMS provides considerable information on sources of information which farmers use in securing different types of information. On the average, six noncommunicative sources of information were used more frequently than 18 communicative sources. See Table 3 for this tabulation and the headings of Tables 4 and 5 for the specific communicative and noncommunicative sources involved.

Among noncommunicative sources, the most used source of information on existing production methods was past experience while the most used source of information on new technology was the observed experience of

Table 2. Number of Selected Midwestern Farmers Assigning Different Degrees of RELATIVE IMPORTANCE TO THE FIVE MAJOR TYPES OF INFORMATION IN SETTING UP AND OPERATING FARMS (1) TO GET THE MOST OUT OF LIFE AND (2) FOR PROFIT, 1954

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D 47	Purp	ose	
Degree of Importance by Type of Information	To Get Most Out Of Life	For Profit	Total
Most Importanta			
Prices	101	251	352
Production Methods	103	222	325
New Technology	20	44	64
Human Information	27	52	79
Institutional	37	55	92
Could not rank a first	3	5	8
Second Most Importantb			
Prices	157	74	231
Production Methods	182	83	265
New Technology	101	42	143
Human Information	69	31	100
Institutional	88	49	137
Could not rank a second	32	12	44
Least Importanto			
Prices	31	25	56
Production Methods	34	9	43
New Technology	145	71	216
Human Information	208	88	296
Institutional	134	70	204
Could not rank a fifth	77	28	105
All equally important	-		100
Could not rank any	-	-	47
Question not answered		_	8
Number of farmers interviewed	1075	1075	1075

a Chi-square = 4.9 with 11.07 required at the 1 per cent level of significance.
 b Chi-square = 1.9 with 11.07 required at the 1 per cent level of significance.
 c Chi-square = 9.2 with 11.07 required at the 1 per cent level of significance.

TABLE 3. USE OF EIGHTEEN COMMUNICATIVE VERSUS SIX NONCOMMUNICATIVE SOURCES OF Information In Securing Five Types of Information by 1075 SELECTED MIDWESTERN FARMERS IN 1954

		Kind of Source							
Type of Information	Commu	nicative	Noncomm	unicative	Both Sources				
	Number	Per cent	Number	Per cent	Number	Per cent			
Prices	4,840	68.7	2,203	31.3	7,043	100			
Production	2,610	58.8	1,827	41.2	4,437	100			
New Technology	926	67.3	450	32.7	1,376	100			
Human	1,067	55.7	848	44.3	1,915	100			
Institutional	2,517	68.0	1,185	32.0	3,702	100			
Total	11,960	64.7	6,513	35.3	18,473	100			

Chi-square = 206.3 with 13.3 required for significance at the 1 per cent level.

Table 4. Noncommunicative Sources of Five Major Types of Information by Numbers of Farmers Reporting Use With Percentage Distributions by Source and Type, 1075 Selected Midwestern Farmers, 1954

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Type of Information	Past Experience	Trial and Error on Whole Operation	Experimentation on a Limited Scale	Observing the Experience of Others	Reasoning from Information Known to Be True	Keeping Written Records	Total for Non- communicative Sources		
	Numbers								
Prices Production New Technology Human Institutions Total	880 619 56 465 526	67 135 33 18 36	99 286 107 44 29	244 452 170 208 212	487 241 80 101 345	426 94 4 12 37	2208 1827 450 848 1185		
	Percentages								
Prices Production New Technology Human Institution	40.0 33.9 12.4 54.9 44.4	3.0 7.4 7.3 2.1 3.0	4.5 15.7 23.8 5.2 2.5	11.1 24.7 37.8 24.5 17.9	22.1 13.2 17.8 11.9 29.1	19.3 5.1 .9 1.4 3.1	100 100 100 100 100		
Total	39.1	4.4	8.7	19.9	19.3	8.8	100		
				Percentag	ges				
Prices Production New Technology Human Institutions	34.6 24.3 2.2 18.3 20.6	23.2 46.7 11.4 6.2 12.5	17.5 50.6 19.0 7.8 5.1	19.0 35.1 13.2 16.2 16.5	38.8 19.2 6.4 8.1 27.5	74.3 16.4 .7 2.1 6.5	33.8 28.1 6.9 13.0 18.2		
Total	100	100	100	100	100	100	100		

Chi-square = 1311.8 with 37.6 required for significance at the 1 per cent level.

others. Past experience and reasoning from information known to be true were important sources of price information, the later result being consistent with a much greater than expected use of economic theory by farmers in forming price expectations revealed elsewhere in the IMS.<sup>5</sup> Past experience was the important source of noncommunicative information concerning institutions and humans.

In the case of communicative sources farm magazine's were the most used sources of production information with county agents, vocational

 $<sup>^{\</sup>rm s}$  The data on price expectations are being analyzed by Earl J. Partenheimer, Michigan State University.

TABLE 5. COMMUNICATIVE SOURCES FOR FIVE MAJOR TYPES OF INFORMATION. BY NUMBERS OF FARMERS REPORTING TIER WITH

Mail Advertising	Number													103 32 40 80 8 839 839 839	818 1425 1206		2.2 1.2 4.3 9.6 7.7 1.4 17.4	1.8 11.9	47.2 46.6 14.7 13.7 18.3 6.2 3.7 2.7 16.1 30.8	100 100
Publications of Farm Organizations Tornal Schools														160 25 24 29 24 5 113 6	436 75		8.8.9.9. 8.9.9.5. 8.9.9.5. 7.1.1. 8.9.9.5.	10 0	36.7 17.2 38.7 5.5 6.7 8.0 8.0 87.6 13.3	100 100
Рагт Маgazines						856 242 29 29 29 29	1898		17.7 19.7 26.1 2.7 10.8	15.9	45.1 3 27.0 1 12.8 1 13.6 3	100								
Publications of Experiment Stations		190 283 59 16 57	605	tages	8.01 8.4.6.8.	5.1	46.8 46.8 4.6 8.6 4.6	100												
Demonstrations, Meetings & Lectures		Nu	116 116 125 15 90	373	Percentages	94440	3.1	3.0.0 8.11 8.13 9.49	100											
Lending Agents  Dealers, Salesmen & Buyers		721 115 1120 120 120	1122		24 25 1 2	9.4	10.04	100												
Managers Bankers and		0 162 5 18 7 5 5 161 1 111	8 457		1.38 4.1	.3 3.8	85 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	0 100												
Neighbors and Relatives Professional Farm		287 80 273 85 79 7 371 15	1305 158		200000	9 1	0 6 1 4 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	100 100												
Truckers, Custom Operators and Route Drivers		102 171 20 20 20 20	189 13		2. 1. 2. 2. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.	1.6 10.	24.0 9.0 26.0 26.0 26.0 26.0 26.0 26.0	100												
Government People		888 272 27 27 27 27 27 27 27 27 27 27 27 27	475		8.1.8	4.0	818.95.44 6.95.95.44 7.95.95.95	100												
County Agent, Vocational Agriculture and Agriculture College Representatives			210 488 87 75 156	9101		18.7 1.0 1.0 6.2	8.5	20.7 48.0 8.6 7.4	100											
People From Farm Organizations		106 72 17 52 52 221	468		94 94 14 90 94 80 80 80 80	8.9	22.6 15.4 11.1 47.3	100												
Organizations		Prices Production 72 New Technology 17 Human Stanford 17 Institutions 221	_		91 00 00 C 00		040=0													

Chi-square = 3781 for 72 degrees of freedom. With 30 degrees of freedom 50.9 is significant at the 1 per cent level.

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Chi-square == 3781 for 72 degrees of freedom. With 30 degrees of freedom 50.9 is significant at the 1 per cent level.

agricultural teachers and agricultural college representatives in close second place. Experiment station publications were third. Obviously, the agricultural colleges are an important source of information concerning existing production methods.

The situation, however, is considerably different in the case of infor-

mation on new technology and prices.

For new technology, farm magazines are in first place with dealers, salesmen and buyers (as a group) second. Newspapers (singly), county agents, vocational agricultural teachers and agricultural college representatives (as a group) and neighbors and relatives (also as a group) are in a weak virtual tie for third. Experiment station publications are in seventh place. It is clear that the agricultural colleges are not used as much directly as are other sources of information on new technology. Even though many magazine, newspaper, and radio presentations about new technologies originate with the agricultural colleges, one must be careful about concluding that these colleges originate all or even most of this information. Many such presentations, for instance, are based on commercial farm sources and industrial sources while almost all advertisements dealing with new technologies come from commercial sources. The relatively small amount of information on new technology in college-printed publications is further reason for caution.

For prices, farm magazines (singly), dealers, salesmen and buyers (as a group), newspapers and radios are the important communicative sources. Past experience was the important noncommunicative source. Agricultural colleges were not important direct sources of price information.

The important communicative source of institutional information was newspapers though farm organization publications and people combined were close competitors. For information on humans, neighbors and relatives (as a group) were the important source of communicative information. Again, agricultural college sources did not play important roles. Clearly, farmer respondents did not always indicate that they used agricultural college sources because it was the "socially acceptable thing to do."

### Kinds of Farmers Using Different Communicative Sources of Information

Different kinds of farmers use different communicative information sources. Even so, when a farmer contacts a source, the pattern of information he obtains may not depend on his characteristics.<sup>6</sup> Analysis has

<sup>&</sup>lt;sup>8</sup> Five hundred and forty X<sup>2</sup> tests of tables relating 30 characteristics of farmers to the kinds of information they secured from 18 different communicative sources failed to reveal a single difference significant at the 5 per cent level. On the other

not yet proceeded far enough to draw the corresponding conclusions for noncommunicative types of information. Though more detailed analysis will reveal what kinds of farmers use which sources, this information is not yet available in fully evaluated form.<sup>7</sup>

### Difficulty Experienced by Farmers in Getting Different Kinds of Information

The types of information used by farmers have been considered along with the importance attached to different kinds of information and the sources of information used by farmers. Another relevant consideration is the difficulty getting different types of information.

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Table 6 indicates that price information was the least difficult type of information to secure for 241 out of 1068 farmers. Of the same number 192 found production information least difficult to secure while only 60 said the same thing about information on new technology. On the other hand, about equal numbers found information on prices, new technology, humans and institutions most difficult to obtain with a somewhat smaller number finding production information most difficult to obtain.

# Information Content of Agricultural College Materials

The data on information patterns used and valued by farmers along with the data on sources used and difficulties encountered in securing different kinds of information suggested that the information content of agricultural college publications be examined.

Data on the information needs of farms can serve as one limited criterion for evaluating the information in agricultural college publications. They cannot serve as the sole criterion for many reasons including (1) the possibility that scientists abreast of forthcoming technical, economic and institutional changes may know the information needs of farmers better than farmers, (2) the possibility that the information can be produced more efficiently elsewhere than in the agricultural colleges and (3) the distinct possibility that information can be distributed more efficiently by non-agricultural college media such as magazines, radio, trade journals, and advertising.

Agricultural college publications place a heavy emphasis on technological information, especially on existing methods of production.8 For the

hand, 111 X² tests of 170 tables relating 34 characteristics of farmers to the communicative sources they use in obtaining different kinds of information revealed differences which were significant at the 5 per cent level.

This analysis is being conducted by Russell Mawby, Michigan State University.

The tabulations for the extension service and experiment station publications were made as follows: Each article, circular or bulletin was reviewed for content with respect to the 42 sub-categories established in coding the types of information which

Table 6. Number of Farmers Indicating Different Relative Difficulties Experienced in Securing Five Major Types of Information, 1075 Selected Midwestern Farmers, 1954

Difference of Toron	Difficulty in Securing					
Relative Difficulty and Types Of Information	Most Difficult	Second Most Difficult	Least Difficult			
Price	150	90	241			
Production	105	115	129			
New Technology	138	122	60			
Human	150	126	97			
Institutional	142	123	95			
Could Not Choose	28	126	97			
All Five Equally Difficult	213	213	213			
All Five Equally Easy	33	33	33			
Could Not Rank Any	109	109	109			
Question Not Answered	7	7	7			
Number of Farmers Interviewed	1075	1075	1075			

Chi-square = 190.5 with 34.8 required at the 1 per cent level.

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seven cooperating states, the 1953-55 pattern of information in printed experiment station and extension publications proved to be an average, of sorts, of the patterns which farmers say they would use in organizing and operating farms. The pattern of information in farm and home development materials and in farm management texts was quite similar to that farmers say they would use in organizing farms, the difference being a somewhat heavier emphasis on information about existing production methods. This suggests that farm and home development workers and farm management teachers are "organization" as contrasted to "operation" oriented. The same appears true of extension and research publications but to a lesser degree. One can speculate that with the trend towards more large scale farms (corporate, contract and/or integrated) the need for repeated reorganization of each farm at the end of normal life cycles may decline. This may tend to require more of an "operation" orientation.

Information on prices. Farmers indicated that price information is used more in operating than in organizing farms. They ranked it as the most important by a narrow margin. Aside from their own experience and reasoning (noncommunicative sources), farm magazines, newspapers,

farmers would use in organizing and operating farms. Each publication received only one check for each sub-category. Thus, any one of the six major information categories could receive only as many checks and references as the head sub-category. The importance of each reference was not weighted. As the same system was used in coding the use which farmers would make of information, comparisons on a relative basis should be quite valid. Similar procedures were used in coding the farm and home development materials. In the case of farm information texts, index entries were tabulated according to the 42 sub-categories.

TABLE 7. A COMPARISON OF FARMER INFORMATION PATTERNS WITH THOSE IN SELECTED AGRICULTURAL COLLEGE MATERIALS AND FARM MANAGEMENT TEXT BOOKS. PERCENTAGE DISTRIBUTION FOR EACH OF SIX MAJOR TYPES OF INFORMATION

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Type of Information	Maj	Major Emphasis for			Information Patterns in				
	Organizing	Operating	Farms for	Printed P	ublications	and Home	Farm Manage- ment Texts <sup>o</sup>		
•	Farms	Profit	Satis- faction	Extension Services <sup>a</sup>	Experiment Station <sup>a</sup>				
	Per cent								
Price Production Methods New Production Technology Human Institutional Home Technology	1.6 53.0 0.1 15.4 29.5 0.4	26.0 44.1 18.1 1.4 9.1 1.3	5.6 14.4 6.4 16.0 50.3 7.3	24.3 46.9 1.1 3.2 17.9 6.5	12.9 58.4 2.1 6.1 17.9 2.6	3.1 74.9 - 13.1 3.6 5.3	11.7 67.4 0.7 4.8 14.5 0.9		
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0		

For the seven states cooperating in I.M.S.
 For five of seven states cooperating in the I.M.S.
 For five texts.

radio and dealers salesmen and buyers as a group were the important communicative sources of price information. County agents, vocational agricultural teachers, college representatives and experiment station publications did not rank high as direct sources. This is consistant with the proportionally small amount of price information in agricultural experiment station publications, but not with the proportionally large amount of price information in extension publications. Consistency is seen, however, when it is realized that many extension reports are the more ultimate source of newspaper, magazine and radio news stories about prices. Farmers ranked price information of high importance. They indicated they would use more in connection with farm operation than in connection with organization but did not indicate unusual difficulty in securing it. The relative amount of price information in college publications agrees, in an average sort of way, with the relative amounts used by farmers in organizing and operating farms. Farmer's opinions about difficulty in procuring price information apparently do not suggest much need for change in the price information content of agricultural college publications or in the channels through which such information passes.

Information on existing production methods. The large amount of information on existing production methods in agricultural college publications is consistent with the tendency of farmers to depend heavily on agricultural colleges and closely related sources for information on existing production methods. It is also consistent with the fact that farmers often indicated that information on existing production methods was least difficult to get. This combines, in a gratifying way, with the high importance farmers attached to such information and the extensive use they indicate they make of it to suggest that the agricultural colleges are serving farmers' needs for production information rather well. Our technical

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departments appear to have done well in supplying a large, important need for a type of information they are well equipped to supply.

Information on new technology. The situation, however, appears somewhat different when information on new technology is considered. In this case, agricultural college materials appear relatively light content-wise while farmers fill their needs substantially, but far from exclusively, from non-agricultural college sources. Both in their indicated use and in their rankings of the different kinds of information, farmers indicated that they regard information on new technology to be moderately important; this is especially true in connection with farm operation. Table 6 indicates, that information on new technology is probably the most difficult (by a narrow margin) type of information for farmers to secure. It appears that for the years considered some opportunity existed for the agricultural colleges to expand their production and distribution of information on new technology.

With rapid scientific and technological advances we can expect this opportunity to grow. The real questions about expanding the proportional emphasis on new technology in the agricultural colleges involve the ability of the agricultural colleges to produce and distribute this type of information. Are we financed and equipped to work on antibiotics, nuclear energy, hormones and synthetic chemicals or are we working with "Edison-like" laboratories in a "nuclear" age? If we have "Edison-like" laboratories could we finance "nuclear" ones?

Information on institutions. There is proportionally less institutional information in agricultural college publications than farmers say they would use in (1) organizing farms and (2) operating them for maximum satisfaction but more than they say they would use in operating for maximum profits. Still further, the institutional information in agricultural publications is likely to deal with state and national rather than local institutions whereas farmers indicated the amount they would use of all three types. It is likely, therefore, that agricultural college publications place about the same proportional emphasis as farmers on information about state and national institutions. Farmers obtained institutional information primarily from their own experience, newspapers, reasoning, neighbors, relatives and radio. Agricultural college sources were of lesser importance and did not serve as significant sources of information on local institutions.

As, obviously, the agricultural colleges are poor sources of information on local institutional arrangements such as churches, schools and drainage associations, the agricultural colleges are probably placing a fairly appro-

This statement is based on more detailed tabulations than those reported in Table 1.

priate proportional emphasis on the kinds of institutional information they can produce.

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This conclusion, however, is not necessarily grounds for complacency. Scientific and technological advance may be creating necessary, if not sufficient, conditions for vastly different economic institutions. Vertical integration, contract farming and our changing governmental programs are cases in point. A careful evaluation by social scientists would probably suggest appropriate kinds of additional institutional information for production and dissemination by the agricultural colleges.

Information on humans. Information on human behavior is used relatively more in organizing farms and in operating for satisfaction than in operating for profit. Few farmers ranked it most important while many ranked it least important. The numbers of farmers finding human information most difficult to secure was not unusually large and the number ranking it least difficult to secure was relatively small. Agricultural colleges and closely related sources were not used extensively as sources of information on humans. In the 1951-55 period, printed agricultural experiment station and extension service publications, and farm management texts contained a proportionally small amount of such information; farm and home development materials contained proportionally more. By and large, the agricultural colleges may not be appropriate agencies for producing and disseminating information about the behavior of specific individuals; however, these institutions may be appropriate sources of broad types of information concerning human behavior. Moreover, the future may hold larger-scale farms employing more hired laborers per farm with a greater need for emphasis on labor relations than now exists.

#### DISCUSSION: NEW KNOWLEDGE OF DECISION-MAKING PROCESSES

B. D. CROSSMON
University of Massachusetts

The title of Johnson's paper is a drawing card. It is more so when one is familiar with his previous writing on managerial concepts and the theory of decision making. Once the cover page is opened, however, the reader may encounter disappointment in finding new knowledge of decision-making processes. Does the mass of empirical data presented by Johnson contribute much to the knowledge of how farmers make decisions? This question reminded me of a boyhood experience of seeking the core of a baseball. With the torn cover removed, a maze of yarn, some with broken ends, confronted me. Which choice of thread would lead me most directly to the heart of the problem?

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In this partial report on the progress of the Interstate Managerial Survey (IMS), Johnson provides tabular summaries of farmers responses on information needed for their decision making. We are not told whether one or several persons did the actual coding of farmers' responses as to sources and kinds of information. This portion of the survey responses may have been fairly easy to objectively code if none of the responses to the oblique and open-ended questions were included. Similar concern extends to the coding of college bulletins as to content.

More important is the interpretation of how farmers used the types of data listed in making decisions. In the first draft of his paper Johnson indicated this was being done. He also outlined project intentions of developing farmers' expectation (prediction) models, their personal strategies, insurance schemes, and wealth utility. Regrettably this new knowledge is not yet available.

This fleeting glimpse of Johnson's hopes gives an indication of the progress of the study. Project leaders in earlier articles have anticipated the process of decision making to include the steps of observing a problem, making an analysis of it, deciding on courses of action, taking one and accepting the consequences. The present paper stops before completion of the analysis step. Furthermore, we are not enlightened on the analytical process of farmers in using the information they say they need. Have the leaders of the IMS bogged down in their interpretation of the anticipated analysis step? Are we offered any empirical direction on how farmers form "observations" of their managerial problems?

All of the anticipated steps involve farmers behavior: observing, analyzing, predicting, acting, and accepting results. From a "nose-counting" approach of farmer interviews, can we expect to learn how and through what steps farmers make their their minds? Last year, Johnson touched on this difficulty. He indicated that farmers have both beliefs and values and that the IMS was weaker in securing the latter. Values, of course, determine final action choice. The present tables of information responses are only indications of certain farmers beliefs and even these are conditioned by ever-present values. Farmers responses to interviewers were conditioned by the desire to appear as rational behaving managers.

Motivation research psychologists have largely discarded the statistical technique of asking people what they want and what they do. They found the answers false. For example, a group of people, from a list of borrowers of a personal finance company, were asked if they borrowed from such sources. All replied no. A brewery study indicated the public preferred its "light" brand of beer three to one but sales of regular beer of the same brand continued nine to one for years. Other examples are plentiful in the current best seller, *The Hidden Persuaders*. The book describes people as "bundles of day-dreams, misty hidden yearnings,

guilt complexes, irrational emotional blockages."—"image lovers given to impulsive and compulsive acts." We give answers hoping the recipients will form the images we desire of ourselves.

So far, the IMS has not described many of the "images" (farmers) and their behavior in decision making. Earlier, project leaders have given us image concepts of inductive and deductive thinking managers. The present progress report only touches on the personal characteristics of farmers and their relationships to information needs. A footnote indicates that when 34 instead of 30 personal characteristics of farmers were tested in relationship to communicative sources of information, significant differences were found. Apparently these four unexplained characteristics are important even when in compound with the others.

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Another image the reader may mentally form in reading Johnson's paper concerns the relatively small number of farmers reporting interest in "new technology." Perhaps our minds see a type of innovator. But we have no clear distinction between "new technology" and "old technology" information. In the tables presented, "Production" and "Production Methods" seem to replace "old" technology. Nor is it clear who wants what.

In summary, I see little benefit from these data on farmers' informational beliefs without an associated array of the types of farmers desiring the data and how these managers actually use the information in decision making. Without more knowledge of farmers' values the whole effort may yield barren fruit. Some supplementary guidance in the area of value determination from psychologists should be helpful.

It has been a stimulation to follow the threads in the development of the IMS, particularly for one outside the interstate region. It was my privilege to attend the 1953 Risk and Uncertainty Conference in Bozeman, Montana where the broad aspects of managerial problems were discussed.<sup>3</sup> This was followed by the enthusiastic papers at the 1955 annual meeting and that of Johnson at the 1957 meeting. I regret the present paper has given me a let-down. This report from the project seems to have shied away from complex managerial problems as they arise on the individual farms. Statistical sorts of information types and sources, still isolated from the differing farmers who provided them, are offered us.

The IMS is certainly a fine example of regional departmental cooperation in research. Still, I cannot term it an interdisciplinary study on farmers' beliefs and values portrayed in their decision-making processes. Managerial decisions extend beyond economics and sociology—even to the subconscious aspects of human behavior.

<sup>&</sup>lt;sup>1</sup> Vance Packard, The Hidden Persuaders, New York: David McKay Co.; 1957. <sup>2</sup> See Journal of Farm Economics, December, 1955, p. 1122-25; and Journal of Farm Economics, December, 1957, p. 1219-20.

<sup>\*</sup>Published as North Dakota Experiment Station Bulletin 400, 1955.

#### FARMERS' DECISIONS IN THE USE OF FERTILIZER

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MOYLE S. WILLIAMS\*
National Plant Food Institute

MANAGERIAL decisions relating to the use of chemical fertilizer are becoming more important, since the increased use of fertilizer has been one of the main features of the technological revolution in agricultural production. Information on how farmers make decisions relating to one production practice should be helpful in understanding the decision making process itself.

A study designed to look at only one kind of the many decisions farmers make has obvious limitations. However, it is felt that a limited study such as the one described here can supplement work being done elsewhere in adding to knowledge of the managerial process.<sup>1</sup>

This paper is based on a study of farmers' attitudes toward the use of fertilizer.<sup>2</sup> The National Plant Food Institute (NPFI) has the over-all objective of encouraging the proper use of fertilizer, consistent with agricultural colleges' programs and activities. We have felt the need to know more about farmers' behavior as related to fertilizer use, so that our efforts could be made more effective. This study was designed to provide the Institute staff and member companies with information that would help in selecting those activities that appear to offer the best means of achieving our overall objective.

# The Study

The study of farmers' decisions in use of fertilizer started with this over-all objective—to discover behavioral, attitudinal and environmental factors which are associated with different levels of fertilizer use by farmers.

Specific study objectives were: (1) To determine how farmers go about deciding on using or not using commercial fertilizer and locate factors which influence this decision, (2) To investigate the association between farmers' general attitudes toward farming (and the future of farming)

<sup>&</sup>lt;sup>o</sup> Delbert L. Rucker has been most helpful in the preparation of this paper. Also, the writer would like to thank Burnell Held and John B. Claar for their helpful suggestions.

<sup>&</sup>lt;sup>1</sup>The terms "decision-making process" and "managerial process" are used in the usual farm management sense. See papers presented on "Progress and Problems in Decision-Making Studies," *Journal of Farm Economics*, December, 1955, pp. 1097-1125.

<sup>&</sup>lt;sup>2</sup>The study, entitled "A Study of Farmers' Attitudes Toward the Use of Fertilizer," was made by National Analysts, Inc., of Philadelphia for the National Plant Food Institute. Copies of the report on the study have been made available in limited quantities to land-grant colleges.

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and their level of use of commercial fertilizer, (3) To find out where farmers seek information about fertilizer and the influence of these sources on farmers' attitudes towards fertilizer, (4) To investigate the association between the level of knowledge and the level of farmers' use of fertilizer, (5) To find out farmers' knowledge of and attitudes toward soil tests and demonstration plots, (6) To describe the major positive and negative attitudes toward commercial fertilizer which are held by farmers with different levels of use.

The research company planned, developed, and carried out the survey and analysis with the close cooperation of the staff of the NPFI and representatives of member companies.<sup>3</sup> In contrast to some other studies of farmers' decisions this was designed as a consumer research project and the methodology used was that normally associated with marketing (or behavioral) research. The importance of this approach has been recognized by Nybroten. "It seems that subjective valuations, which ultimately must be part of any transaction, are often inadvertently forgotten by analysts if the business transactions involve production goods, even though the same analysts might be perfectly aware of this if the transactions involve consumer goods."<sup>4</sup>

The study was developed so that information would be available for five major regions of the country. The population studied was those farmers who operate farms of 100 acres or more and excludes share-croppers (as defined by census). The sample design used was a stratified, multi-stage, cluster, area probability sample.<sup>5</sup>

Since the universe was different from the census enumeration of all farms, screening was necessary to determine eligible farmers. Altogether, 500 segments of areas were selected from 80 sample counties. The sample used gave 1891 useable questionnaires.

The information was collected from farmers by the survey method in late summer, 1957. A structured questionnaire composed mainly of multiple choice, preceded, and open-end type questions was used.

The data were cross-tabulated by level of use. The "level of use"

<sup>&</sup>lt;sup>3</sup> The planning and development of the study was under the direction of Dr. F. P. Kilpatrick, a psychologist. The survey and analysis were supervised by Mrs. Jean Szaloczi, a sociologist. The study teams also included a statistician, a mathematician, and an agricultural economist. For more on how a private research company approaches research, see F. P. Kilpatrick, "New Methods of Measuring Consumer Preferences and Motivation," *Journal of Farm Economics*, December, 1957, pp. 1813-1320.

<sup>&</sup>lt;sup>4</sup> Norman Nybroten, "Methods of Studying Attitudes Relevant to the Economics of Fertilizer Marketing," Economic and Technical Analysis of Fertilizer Innovations and Resource Use, Ames: The Iowa State College Press, 1957, pp. 117-118.

<sup>5</sup> Details on sampling and methodology are shown in Analytic Report on the study.

Details on sampling and methodology are shown in Analytic Report on the study. The "level of use" refers to amount of fertilizer used on the farmer's two most important crops (as determined by the farmer) for the crop year 1956. High users

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was a subjective classification made of each questionnaire by agronomists from each region who were intimately acquainted with farming and soil conditions in the particular region. This classification was necessary to achieve the objectives of the study, and worked very well. Objective methods of classification tried were not satisfactory.

Specific questions on fertilizer were asked about the two most important crops grown, as designated by the farmer. It was felt the farmer would be more likely to follow recommended practices on crops he considered most important. Hence, 14 per cent of those classed as non-users used some fertilizer on other crops on the farm.

The interpretation of results drew heavily upon present knowledge of social, psychological, and economic aspects of human behavior in general and farmers' behavior in particular. These interpretations are presented as general conclusions and no attempt is made here to cite the statistical data on which these conclusions are based.

#### Results

Here are some of the more important findings from the study as based on the analysis by National Analysts, Inc., and summarized by the staff of NPFI:

- (1) The "average" farmer's knowledge about fertilizer is surprisingly limited. He does not seem to understand clearly the meaning of analysis, grade or ratio.
- (2) Because of limited knowledge and lack of understanding about fertilizer, much information, especially about analysis and amount, is not effective in influencing farmers' thoughts and behavior.
- (3) The average farmer rates county agents and agricultural college publications very high as sources of practical fertilizer information.
- (4) Despite No. 3, he more often discusses his fertilizer needs with others such as his local fertilizer dealer or neighbors before buying.
- (5) The farmer reads and hears (on radio and television) about fertilizer. Yet such contracts lead to action only infrequently.
  - (6) Farm magazines are the principal reading sources.
- (7) Discussions most often led to specific action relating to use of fertilizer.
- (8) Analysis, amount and price are the three subjects discussed most often. Analysis and amount are of more interest than price.
- (9) Other than own judgment and trial and error, soil test recommendations appear to be most important influence on farmers' use of fertilizer.

were those using rates in the range of those recommended by the state experiment station. Other classifications were medium, low and none. A non-user was a farmer who used no commercial fertilizer on the crops selected for detailed questioning.

(10) Non-users most often gave "not enough money" as the reason for not using fertilizer. This probably means that they use available funds to buy products they consider more likely to bring dollar returns or give personal or family satisfactions.

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(11) Unfavorable weather was given almost as often as lack of money

as a reason for not using fertilizer.

12) Only 11 per cent of all farmers use fertilizer on either of their  $t_{WO}$  most important crops at rates approaching those recommended by their state experiment stations. About 37 per cent used no chemical fertilizer on either of their two most important crops.

The characteristics of farmers in one level-of-use group frequently were quite different from those of farmers in the other groups. Generally, there was a high correlation between the level of fertilizer use and the characteristics associated with the more efficient farmers. By this, I mean the high fertilizer users were usually those who had larger farms, larger investments, higher education, and the other social and economic characteristics generally associated with the "good" farm manager. The study made no attempt to use quantitative measures. The effort was to determine attitudes and behavioral patterns rather than fertilizer consumed per acre or statistically reliable information on farm organization and operation.

The study had the advantage of looking at one type of decision that is made by most farmers. We were concerned with an easily identifiable practice. Research results are available indicating expected results from the use of fertilizer and most states have had fairly intensive educational programs to teach farmers more about how to use fertilizer. We have felt that one of the weaknesses in educational efforts was the lack of attention to the economics of fertilizer use. Results from this study substantiate that view.

The study indicates a rather strong reliance of farmers on induction as a means of making decisions about the use of fertilizer. It appears from the study that many farmers do not transfer fertilization practices from one crop to another. Apparently many farmers feel that what works on corn does not necessarily work on wheat. Certainly this is true in terms of specific analysis and amount. Many farmers apparently do not learn by experience the principles of fertilization which permit them to fertilize all their crops at the optimum level. As much as anything else, this indicates that educational methods used apparently have not really developed managerial ability, at least as it relates to decisions on fertilizer use.

The questionnaire was developed so that the same information was asked through the use of different questions at several points in the course of the interview. An example is the effort to find out which sources

of information farmers actually used when they were deciding about the purchase of fertilizer. The farmers rated county agents and college publications far above all other sources as "reliable sources of practical fertilizer information." However, when we asked farmers with whom they discussed their fertilizer needs and what they had read, seen and heard, contacts with fertilizer dealers were reported much more often than with county agents. It seems to me that this illustrates one of the problems in this type of research effort. Had we stopped with asking farmers how they rated the various sources of information, we may have drawn the conclusion that the fertilizer dealer was not important as an informational source. Apparently, just the opposite is true.

A substantial part of the study attempted to determine farmers' attitudes as they affect his fertilization practices. Based on the results of the study, a good farmer's ideal appears to revolve around good farming practices, particularly the use of fertilizer and crop rotation, more often than around possession of land or equipment. The high-level fertilizer user seems to have a more business-like or "managerial" approach to his farm operation. He is more optimistic about the future of farming and more often has plans for increasing income. He apparently achieves his income expecta-

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Projective techniques were used to determine farmers' attitudes toward the future opportunities of farmers such as themselves and why they felt this way. About half the farmers thought things would be generally worse, about one-fourth thought they would be generally better and the remaining one-fourth said things would be about the same. The reasons given were weighted heavily by economic factors. Those who thought things would be generally better listed the following factors in order of importance: prices and price situation, economic and market conditions, farming technological advances, government farm controls, and the trend toward larger farms. Those who thought the future would be about the same as now most often gave their reasons in terms of prices and price situation, economic and marketing conditions, cost of production, government farm controls. Those who thought the future would be generally worse most often gave their reasons for feeling this way in terms of cost of production, prices and price situation, government farm controls, economic and market conditions, and the trend toward larger farms.

There was an indication that a general air of pessimism prevailed among farmers in each of the four regions. Generally, they tended to blame influences that they felt were beyond their control. The farmer who has little hope for the future and thinks that there is little he can do about improving it is not as likely to adopt new production methods. The more efficient farmer (who is also the high fertilizer user) had more confidence in his ability to influence his own destiny. He tended to give

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rather specific reasons for his satisfaction or dissatisfaction and seemed to be willing to accept responsibility for his own situation. On the other hand, the lower income farmers appeared to be unable to accept any responsibility for their present situation and blamed it almost entirely on factors which they could not influence.

To get more insight into how farmers decided on fertilization practices, farmers were asked how they first decided on the analysis and amount of fertilizer that they used on their crops in 1956. Trial and error, own judgment, and recommendations of other farmers were given more often than were soil tests and the advice of agricultural experts. Farmers have a tendency to make frequent changes in analysis and amount over previous years. This indicates a low level of conviction and suggests a lack of self-qualification in selecting the proper analysis and amount. Many farmers seem to have a fear of using too much rather than a positive feeling that their present practice is a correct one. They seem to be motivated more by the fear of loss than by the prospect of gain. This leads one to question whether or not profit maximization really is the motivating or overriding influence.

It appears that psychological factors are of great importance in farmers' decisions. This lends support to the framework as outlined by Johnson. "It can be concluded that the methods of analysis employed by farm managers include all systems of inductive and deductive thought formalized by man as well as many systems yet to be formalized. When one takes a broad view of decision making, it is apparent that economic logic is only one form of logic in farm management and that it alone is far too narrow to handle the range of problems encountered by farm managers."

Over half of the farmers who did use fertilizer on their selected crop reported having discussed the matter with one or more people. They most often talked about it in this order: with the local dealer, county agent, other farmers and Soil Conservation Service personnel. The things they most often talked about were analysis, amount and price. Over three-fourths said their discussions led to specific action.

Another indication of the reliance on the induction method was the lively interest revealed by farmers in soil tests, demonstration plots and experimentation with fertilizer. A surprisingly large percentage of the farmers consistently gave credit to soil testing as a basis for their present fertilization practices. Undoubtedly, we have some of the "sociably acceptable" answering, but even allowing for this, soil testing apparently has considerable influence on farmers' decisions relating to fertilizer use.

On the other hand, farmers tend to view the results of their crop production practices as a global "yield per acre" and do not readily dissect the

<sup>&</sup>lt;sup>7</sup> Glenn Johnson, "The Role of Management in Planning Farms for Optimum Fertilizer Use," Fertilizer Innovations and Resource Use, p. 268.

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factors which contributed to achieving those results. It appears that very few farmers translated the results of the use of fertilizer into terms of more returns or more profit per acre. Undoubtedly, this was one of their objectives. Yet, this presents a problem in teaching farmers the economic principles involved in the use of fertilizer. It appears that we still need to concentrate on basic education in rather simple economic principles such as marginal analysis.

### Conclusions and Implications

Much of the past work on farmers' decisions has had the major weakness of lacking a formalized, guiding body of theory. This theory is rapidly developing, both relating to farmers' decisions and to managerial decisions in industrial firms. With sharply defined managerial concepts, empirical research on the decision making process should be much more productive.<sup>8</sup>

The work on the Interstate Managerial Study (IMS) by the North Central Farm Management Research committee has pointed up the long-felt need for more knowledge and a better understanding of the managerial process in agriculture. The IMS is a milestone.

Research on why farmers do what they do and how they decide on courses of action must include more than economics. Contemporary psychological theory has contributed to the understanding of human behavior.9

The importance of sociological concepts, such as "status" in the social group is being recognized as extremely important. <sup>10</sup> Yet the specialization of social science presents difficulties in insuring the utilization of the appropriate disciplines.

The "team approach" used by National Analysts, Inc., is worth studying. This research organization has the flexibility to constitute a team composed of trained scientists from the different disciplines suited for the particular study problem under consideration.

The understanding of farmers' behavioral patterns must draw on the humanities (religion, ethnics, etc.) as well as the sciences. <sup>11</sup> Part of the difficulty at present is determining who should take the leadership and who should synthesize the results.

<sup>&</sup>lt;sup>8</sup> Most of the work on the adoption of new practices has dealt with decision-making. The lack of reference points has led to some confusion between the diffusion process and the managerial process. The splendid work of Beal and Bohlen have helped clear up some of the confusion.

See James A. Bayton, "Motivation, Cognition, Learning-Basic Factors in Consumer Behavior," Journal of Marketing, January, 1958, pp. 282-289.

\*\*Everett M. Rogers and George M. Beal, Reference Group Influence in the Adop-

<sup>&</sup>quot;Everett M. Rogers and George M. Beal, Reference Group Influence in the Adoption of Agricultural Technology, Department of Economics and Sociology, Iowa State College, 1958.

<sup>&</sup>lt;sup>11</sup> This idea has been presented by Johnson, loc. cit.

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A comprehensive empirical study of the decision-making process becomes very expensive, especially if a national sample is used. Consequently, there is considerable merit in intensively studying limited aspects of how farmers make decisions. A series of such studies, done on a state, regional, or national basis, should help fill in the gaps in existing knowledge and theory.

It generally is agreed by agricultural economists that the survey is a very valuable method if properly used. It is a truism to say that the results can be no better than the information collected in the interview. The development of the questionnaire continues to be the key to usable results from a survey. This is the most important and most difficult part of a study such as the one described.

Unless pretesting indicates that developed hypotheses can be tested, the study should not be made. Other hypotheses capable of test must be developed. Too often behavioral research is expected to give the answers somewhat magically. Understanding its limitations is an important part of behavioral research.

Essentially, contemporary behavioral research deals with an ordering of knowledge rather than the exploration of the completely unknown. The information received is always subject to interpretation. Hence, the results can never be presented as "facts."

One of the pitfalls of the interview, especially with the interviewers not trained in the social sciences, is the "socially acceptable" answer. It is almost impossible to avoid. Farmers' replies to several questions in the study discussed above indicated we had not been able to entirely avoid this pitfall. The best protection appears to be to construct the questionnaire so that several answers are received to different questions on the same topic. Of course, the question has to be worded differently each time it is asked. This permits a check for internal consistency and gives confidence in answers where such consistency is evident.

Another problem is to avoid drawing unwarranted conclusions from what may be inadequate evidence. This always is emphasized in connection with the "scientific method." Equally dangerous to me is the failure to draw any conclusions. In the physical sciences, theory and often limited observation are used to make rather specific recommendations for courses of action. If behavioral research is worth doing at all, it must provide information that shapes action. Waiting for "complete" information is the best way I know to become completely inanimate.

Based on the results of the Institute's study, I arrive at the following conclusions:

(1) There is a need for improvement in our educational methods (especially in communication), at least dealing with soil fertility.

(2) There is an urgent need, both for educators and for industry, to know more about the managerial process itself.

(3) Educational efforts, to be effective, must take advantage of the idea that different groups of farmers use different processes in arriving at decisions.12

(4) Educational programs which lead to action must take into account the psychological factors influencing farmers' behavior. These have been implicitly recognized by many extension workers, for example, but are

not explicit in most action programs.

(5) Information useful in the decision-making process must be presented in terms the individual understands and sees as applying to his own situation. This is an old refrain but it is hard to overestimate its importance.13 The sophisticated farmer familiar with theoretical concepts is not stimulated by a recitation of test plot results. However, the farmer who bases decisions on emotional reaction is repelled by even such simple data as yield results. Farm and Home Development has offered the opportunity to tailor information for the individual, but I fear has not realized its potential.

The results of the study on farmers' fertilizer decisions have been enthusiastically received by the fertilizer industry. This is the kind of information for which industry is searching. More attention to this area by land-grant colleges will be appreciated by all of our constituents and, I'm sure, by other agricultural industries.

#### DISCUSSION: FARMERS' DECISIONS IN THE USE OF FERTILIZER

ERMOND H. HARTMANS University of Minnesota

The title of Williams' paper, "Farmers Decisions in the Use of Fertilizer," appears to suggest a broader scope of analysis than the study of the National Plant Food Institute (NPFI) actually covered or intended to cover.

Various steps of the decision-making process have often been identified. The subcommittee of the North Central Sociology committee distinquished five stages: (1) the awareness stage, (2) the interest stage, (3) the evaluation stage, (4) the trial stage and (5) the adoption stage.

The NPFI study deals primarily with the question of how farmers became aware and interested in fertilizer and to some extent what factors

"Heady outlined this in his presentation, "Possible Implications of the North Central Interstate Managerial Study for Farm and Home Development Programs," Journal of Farm Economics, December, 1957, pp. 1122-1125.

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<sup>&</sup>quot;The following quote from National Project in Agricultural Communications emphasizes the point: "It seems that most people have the ability to learn rather than a burning desire to learn. They can learn if their WILL to learn is aroused. . . . Thus, it is possible to say that we can communicate without educating but that we can hardly educate without communicating."

influenced them in the final stages of adoption. Which production economic factors really played a role in the decisions to use fertilizer and to determine the rate of fertilization is practically left untouched.

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There are also some inconsistencies in this paper. Trial and error, own judgment and other farmers are mentioned in one place as primary sources of farmers' decisions in their present use of fertilizer, while in another place, soil tests were indicated as the most important basis for present fertilization practices. This apparently reflects the dangers and weaknesses of the survey method for this type of a study. Williams correctly points at this in his paper. However, the study reveals some very important facts which should raise some questions about our tasks as economists in the adoption phase of the constant stream of new technological developments and practices. While research and extension publications of universities and industries, radio, press, and communications of county agents and other agencies are still functioning as effective means of mass information and as such create awareness and interest the present educational services beyond the mass information stage do not appear to be highly effective in enabling farmers to use deduction and analysis as a means of decision making. This is not because there is little known about the factors that determine the optimum level of adoption. but because these factors and tools of analysis apparently do not reach the farmer in a form which he can understand or else the arguments are not convincing. The NPFI study indicates that farmers' decisions are strongly influenced by persons who have little information concerning the production and resource factors of the individual farm units, such as dealers, friends, neighbors and specialists at a university who make soil test recommendations. Such decisions can be hardly based on any type of marginal analysis. Therefore, application of a new or existing technology if often based on trial and error or arbitrary decisions.

Two lines of thought can be followed at this point:

I. The available economic information should be more adequately popularized and incorporated in information that is more readily acceptable to the farmer. Let us relate this to the use of fertilizer.

Few agronomists, economists or good farmers would question the economic significance of a certain rate of fertilization under practically any farm condition. Yet 37 per cent of the farmers in the survey did not use any fertilizer on their two major crops. Not because they hadn't heard about fertilizer, but apparently because what they had heard was insufficiently inducive to get action. Maybe we have not used the right combinations of "appeals" in "selling" fertilization practices.

Most information used by agronomy and industry people highlights increases in yield per acre and sometimes, but less frequently, net return per

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acre. Williams' paper indicates this too. Most frequently, yield response data of one year and one crop are used, implying that a farmer should try for maximum yields and maximum return per acre. (Two already incompatible objectives.) Rarely, if ever, is the use of fertilizer in educational programs related to over-all farm planning. Some of the important economic considerations within the present structure of agriculture are:

- The return per dollar of capital invested in fertilizer relative to other production items, while measuring the effect of fertilizer on the entire crop rotation. Recommendations based on soil test might well be made on the basis of extreme limitation, moderate limitation and no limitation of capital supply.
- Coupled with the consideration of capital, consideration of the effect of fertilizer use on size of business. Intensifying present acres is often a more profitable use of capital rather than adding extra acres to meet increasing requirements of size of business.
- 3. The effect and rate of fertilization on cost per unit of product particularly in light of declining prices of crops. In summary these considerations make the use of fertilizer an intricate part of the total farm business and require that these decisions be made within the economic framework of the actual farm situation. Fertilizer use becomes a logical part of determining the optimum income potential of the farm.

In this light it is very logical that farmers who Williams identified as "good farm managers" are heavier users of fertilizers since they do understand and consider the above factors. Such an approach however will require much closer cooperation and coordination of agronomists, industry people and economists than exists at the present time.

II. Accept the idea that farmers will gradually rely more and more on specialized persons for every phase of their farm business. The farmer himself will be more of an administrator-coordinator who takes the advice of the "specialists." More educational efforts in that case will have to be directed towards leaders the farmer will depend on, such as county agents, dealers, bankers, farm managers, etc. Whatever the development will be, much closer working relations between subject matter areas and economists will be required. Many of the new technologies and their application require the initial study of a taskforce of specialists at the university level to be followed by a thorough coordinated educational effort.

Although my emphasis in this discussion is primarily focused on the importance of simple, partial or total farm budgeting based on the marginal approach, I do not lose sight of the importance of such factors as the socio-economic status, age of family, composition, educational level, stage in the family cycle, etc. These factors the farm family will exercise correctly only if the farm business or parts of the farm business are understood in their purely economic considerations.

# USING PROCESS ANALYSIS TO IMPROVE FARM ORGANIZATION

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#### Our Heritage

ECONOMISTS of the 19th century provided us with an excellent model for the economic appraisal of production problems. This model was constructed under certain explicit assumptions and many implicit ones. As in the case of all such logical devices, its usefulness depends upon a recognition of all the assumptions and an appraisal of their

adequacy as a simplification of a real problem.

From 1900 to the present, many discussions in our science have centered around the reality and applicability of these assumptions. Some were of a generic nature beyond the scope of present empiricism. Northrop has described this condition as follows: "By restricting itself to the generic properties of the introspected valuations, economics has accomplished something unique in the method of empirical science; it has attained deductively formulated theory which is empirically verified directly through its postulates without the need of appeal to their deductive consequences."

Others dealt with characteristics of the environment within which the firm was considered. It was this latter group which has given the most trouble. Some of the explicit assumptions imposed restrictions far more stringent than was realized. Others were not explicit and gave rise to

problems which troubled users of the tool for many years.

Of several which will be discussed, one assumption—that of perfect knowledge—is of particular relevance to the present topic. Attempts to be more realistic led scientists to seek empirically, first, a mean input—output relationship and, next, the functional relationship between inputs and outputs. Measures of dispersion were given to show variability, and later, probability statements were added to recognize that only a part of the universe had been studied and that predictive errors were possible. Classifications were introduced to permit comparisons of the cost structures based upon the physical relationships under different sets of conditions that is, one method versus another, one soil type versus another, one size versus another.

Several problems resulted from these procedures. I have called them (1) the problem of parallels, (2) the problem of backward orientation, and (3) the problem of optimum response.

Let us examine first the problem of optimum response. Whenever a

<sup>&</sup>lt;sup>1</sup> F. S. C. Northrop, The Logic of the Sciences and the Humanities, New York: Macmillan Company, 1953, p. 247.

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functional relationship is studied empirically, certain inputs are variable, certain ones are held fixed, and the influence of others is neutralized by statistical procedures. This technique works well as long as the output response mechanism gives the optimum response. With a wheat plant or an alfalfa plant optimum response is realized within the limits of the situation. That is, these plants will perform to the best of their ability under the experimental conditions imposed. A meaningful comparison can be made, therefore, of the response of two alfalfa varieties to specific treatments, given certain fixed inputs and a neutralization of the effects of other inputs.

When one employs more complicated living organisms, optimum response is less certain. This is particularly true of the output of human labor. Output per unit of labor using a specified group of resources may be far from an optimum level. Work method, effort, and skill all combine to determine individual worker accomplishment. Variation in these elements leads to wide variability in output. Comparisons among workers for a particular situation are possible from these results, but even here the problem is important because of the large variability around the mean

and lower levels of confidence in the relationship.

This brings up the second problem, that of parallels. In much of our work, cost comparisons are made between alternative factor combinations among firms. Frequently, one wishes to compare worker-method combinations or worker-machine combinations, and different management practices are recommended or rejected upon the basis of such evalutions. On such comparisons, the failure to achieve similar levels of response may invalidate the comparisons. One may correctly object that the failure results from a failure to hold certain inputs (method, skill, effort) constant among groups. In part, this is true, but we are upon the fringe of new phenomena. Some knotty and subtle problems must be answered. Is a worker who is unknowingly using high skill and effort on an ineffective method violating the fixity requirements in comparison with a worker who unknowingly is using the same level of skill and effort with a more effective method? This is a philosophical question requiring judgments on what is knowledge and how one can judge one kind of knowledge versus another. But suppose we grant that one needs to correct for this difference of method, of effort or skill, how is the correction to be made? Can we compare the technical relationship of different machines or methods by using the same workers? Are they the same workers? Anyone giving a quick affirmative to this last question is referred to the Hawthorne experiments.<sup>2</sup> When we toy with the human mechanism we set in motion unknown changes.

<sup>&</sup>lt;sup>2</sup> Stuart Chase, *The Proper Study of Mankind*, New York: Harper & Brothers, 1948, pp. 137-146.

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This problem of parallels looms large in the minds of some agricultural economists familiar with these comparisons. Brunk and Thompson state many comparative cost studies made by economists have implied that differences in output were due to work method, where in reality this may or may not have been true because of the influence of worker skill and/or effort. For example, the conclusion reached from such a study might be that Firm A has a lower unit cost for a given operation than Firm B, and therefore the physical operating system described for Firm A is superior to the one used by Firm B. In all too many instances comparisons of this sort do not hold valid for many reasons. Differences associated with method or skill may emerge in the quality of products produced by the two firms; or still more troublesome, differences due to skill and/or effort rather than to the method followed may show in the output of workers. In other words, it is entirely conceivable that Firm B (and not Firm A) has the best operating procedure; and that the research technique that will expose this fact has been lacking.3

The third problem, that of backward orientation, needs brief discussion. The technical relationships discovered and the cost and returns structure which can be obtained from these relationships are based upon historical results. To a large extent all knowledge is so orientated. But in the area of decision-making on farm firms, these data are used for forward looking purposes.

Conventional methods of making cost comparisons among alternatives make it impossible to appraise quickly any new innovation. They are limited to comparisons of rather standard practices that exist with considerable frequency in a sample group. The appraisal of the impact of a new technique or any new combination of existing techniques is not possible with these research techniques.

This problem is of particular importance as we move into a period of major organizational changes on farms. Larger and more highly mechanized farm units and a narrowing of profit margins will require the early adoption of economic practice in the form of technological innovations.

# Process Analysis

A background has now been laid by discussing a portion of our economic heritage and some of the problems that arise in its use as a logical guide. These problems can be avoided or minimized through the use of process analysis on the farm firm.

Process analysis is a method of providing the operator of a firm with a

<sup>&</sup>lt;sup>3</sup> M. E. Brunk and J. C. Thompson, "Maximizing Worker Productivity Through Evaluation of Its Components—A Hypothesis," *Journal of Farm Economics*, August, 1951, p. 383.

quantitative basis for decisions regarding the use of resources under his control. The quantitative evaluations are in terms of the physical and monetary effects which may be expected if specific action is taken.

The physical effects become the starting point. The farm business is visualized not as a process where required inputs result in final outputs with time nearly neglected, but as a series of integrated processes or stages which, when aggregated over time, result in the final output of the firm. "Thus, a stage consists of all productive services-durable or nondurable-that cooperate in performing a single operation or a group of minor but closely related operations."4

The coordination of stages within the total input-output phenomenon has been described by French, Sammet, and Bressler as follows: . . . "the production process begins with the receipt of some basic material, either in raw or partially processed form. This is the first stage in the plant operations. The material is then transported to a second stage where its form is in some way transformed. It then moves to another stage where another transformation occurs. [In the example, a by-product is removed at this point and flows in another direction where it may also receive additional treatment at successive stages.] At various points other materials are received, then transformed in various stages, and finally are fed into the main line of flow, where they are combined with other partially completed products. Various of the partially completed products may be "split off" at different stages and given different treatments through a new series of stages so that finally several types of completed products emerge from the production lines. The specific patterns of flow will, of course, vary with different products and different plants but this illustration is indicative of their general nature."5

They discuss further the significance of transportation within and between stages, and of temporary storage as vital practices to achieve the integration of stages and the flow of the production process. For example, storage compensates for the discrepancies between irregular supply of input and use of storage as a regular production requirement or factor. Storage also makes it possible for workers to perform different tasks during a given time period. These researchers observe also that in the shortrun there is only a limited degree of factor substitution. Inputs and outputs are often characterized by rigid specifications. Substitution possibilities are primarily between capital and labor and are realized only in the long-run.

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B. C. French, L. L. Sammet, R. G. Bressler, "Economic Efficiency in Plant Operation with Special Reference to the Marketing of California Pears," Hilgardia, Vol. 24, July, 1956, p. 545. \*Ibid., p. 545.

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Before discussing the economic implications of these forces, I wish to turn back to the stage or process. This unit of analysis holds the key to economic organization of the firm. The stage has already been defined as a basic segment of the production activity. It is an independent entity to the extent that alternative practices can be employed to achieve the function of the stage. It is economically independent if, for any given output of the firm, the technologies of no other stage are limited or modified. As this is an unusual situation, the joint relationships of many stages must be planned simultaneously. How is this done? Where does one start?

Brunk and Thompson build a strong case for isolating and evaluating the components of worker productivity—method, effort, and skill. They believe that by so doing they can identify the causal forces behind output differences in comparative cost studies.<sup>6</sup> To this end, cooperative research between the State College of Agriculture at Cornell University and the Agricultural Marketing Service was undertaken and results have been reported,<sup>7</sup> Time and skill requirements for certain basic tasks were obtained under laboratory conditions. The components of activity are additive and can combine to make projections for production estimates.

This seems to be a highly creditable beginning as a basis for discrimination among alternative methods. Other evaluation techniques have been made by other workers, although there may be more subjectivity in their criteria of performance rates. Several studies at the Storrs agricultural experiment station have developed standards of worker performance under rigidly defined situations for many of the activities found on modern farms. An approach to laboratory control was obtained under field condition by breaking each activity down into necessary jobs, operations, and elements. Each was defined acurately and all lower order classifications were additive to achieve the next higher classification. Properly defined, these classifications include all necessary work to perform the entire activity including beginning and ending elements, necessary delays, etc. In addition, an allowance was incorporated for unanticipated external delays by refering to the actual proportionate time experience from field data.

Arrays were then made of the time experience of various workers in performing these necessary work subdivisions. From these, standards of performance were developed for each subdivision and the entire activity by using the average performance rate of the upper 50 per cent of the array. This step was taken to reflect the superior performance of certain workers. Primarily it was a technique to discover superior skill and effort

<sup>6</sup> Brunk and Thompson, op. cit., p. 383.

<sup>&</sup>lt;sup>7</sup> J. C. Thompson, P. V. Weaver, M. E. Brunk, *Time and Skill Requirements for Handling Agricultural Products at Fixed Work Place*, Agriculture Marketing Service, USDA, 197, July, 1957.

for the ultimate method did not necessarily duplicate any method discovered in use.

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ents for Service, In a recent conversation with Raymond Bressler, he reported that similar methods were used by Sammet and himself in an analysis of pear processing in California. Here, however, a regression equation was fitted to the data lying above the average regression equation. Again, this is an attempt to incorporate superior performance with a minimum of subjectivity.

These research works are reported now only to indicate that several methods are already in use to assist in an evaluation of alternative worker productivity under specific situations. The methods cope with the three problems discussed earlier. Optimum performance can now be synthesized for a specific activity. When combined with work simplification techniques, the input-output relationship moves toward optimum levels of response. Standards of performance can be constructed for an activity and can incorporate superior techniques which may not be in existence in total. The time may soon be here when work standards can be established for activities no farm operator has ever used. This will indeed shift our outlook to a forward orientation—from a survey of existing methods to the estimation of the impact of new and untried techniques. And finally, these adjustments will place alternative methods on a more equal footing for a more successful comparison of the physical and economic impact upon the farm business.

Process analysis now takes on a powerful operational role in the organization of the farm business. Each stage becomes a building block. Combining blocks and erecting block upon block permits a synthesis of the organizational resource plan which will function within each planning period. Revision of some stage or stages permits a new structure which will function within the next planning period.

It is at these levels that our economic theory can be of greatest help. Our 19th century heritage asks us to bridge too great a gap in thinking of the total inputs and costs and total returns of the final output when complex relationships occurred in the production process. Modifications of this theory and their application to economic stages make a more useful tool.

Once the physical comparisons among alternative methods for each stage have been obtained, a choice is possible through economic concepts. Construction of the long-run planning curve will determine optimum operational procedures. This planning curve must be developed, however, through the development of many short-run cost comparisons for alternative organizations.<sup>8</sup> In these evaluations, opportunity will exist

<sup>&</sup>lt;sup>8</sup> I. F. Fellows, G. E. Frick, and S. B. Weeks, *Production Efficiency in New England Dairy Farms*, Storrs Agricultural Experiment Station, Bulletin 285, Feb., 1952.

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to meet the problems of discontinuities in factors and of segmentation of the production process. Discontinuities imply that profit maximization for the firm may not be achieved by equating rates of change in costs and returns. The cost and return functions must be examined directly over a wide range to determine optimum organization. Segmentation requires a harmonious combination of stages to exploit the fixed resources. "With technology constant, this amounts to finding a common denominator of the capacities of all the durable factors which may be employed at various stages—this common denominator representing the rate of output minimizing the average total unit cost of operation."

The coordination between the short-run cost curves and long-run planning cost curves is achieved through a three step procedure. "When alternative combinations of resources and production practices are tested for each farm by estimating the total costs, the derived unit costs can be represented by a cluster of points. The combinations that do not alter the quantity of output will appear as a vertical row of points. The lowest point will be the most economically efficient combination derived within the limits of the methodology. The others will indicate less efficient combinations. The combinations that alter the output of the farm will locate points to the left and right of the vertical row. Each of the points will be located on an average total unit cost curve representing a particular combination of resources and technology for the farm. But one would not know the position of the point on the curve nor the shape of the curve.

"An infinite number of points could appear in the cluster. By choosing a few strategic combinations, however, the general location of the combination giving the lowest per unit cost can be obtained for a firm of specified size. This is the first step. It is of primary importance in our problem because all other points at this size indicate less efficient production combinations and techniques and represent irrational action in view of our theoretical framework. This step also introduces some of the fixities that are essential in development of the short-run average total cost curve for each unit.

"In the resource combination and practices which result in the least-cost combination for a particular size, certain resources are fixed in the short-run and costs for these resources do not vary with changes in output. Other resources, variable in the short-run, can be altered to shift the output. Budgeting the influence of variation in these resources indicates the shape of the total average unit cost curve for each farm. This is the second step.

"When these two steps have been completed, for several units of

French, Sammet, Bressler, op. cit., pp. 555-556.

different size, the long-run industry scale curve can be estimated under the assumptions of the study. This is the third step."10

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With the establishment of the long-run planning curve, optimum plant organization and operation is indicated for units of various sizes. Successful comparisons among alternatives are achieved and a forward looking method is available to the operator as a basis for his management decisions.

### DISCUSSION: USING PROCESS ANALYSIS TO IMPROVE FARM ORGANIZATION

ROY N. VAN ARSDALL Agricultural Research Service

The use of process analysis to improve farm organization has been presented in a framework that includes discussion of economic theory, measurement techniques, and methods of analysis. Attempts to fulfill the assumption of perfect knowledge that has been handed down to us with our economic theory are said to have given rise to many problems. These are discussed in the setting of (1) the problem of parallels, (2) the problem of backward orientation, and (3) the problem of optimum response. Process analysis of the farm firm is then credited with having the capacity to avoid or minimize these problems. Finally, a procedure is set forth for establishing short-run and long-run planning curves, thus making possible the selection of optimum organization for units of a given size.

My evaluation of Fellows' paper is limited to some extent because of lack of adequate definitions for a few key terms. First, I am not sure that all of us have the same concept of process analysis as used in farm-management research.

Process analysis is not a complete method of study in itself. To me, it means the classification of processes into their component parts. It is a tool borrowed by economists from engineers. Events within a process are recorded in proper sequence along with selected information concerning each. The type and amount of data obtained may vary from simple description to a mass of detail such as might be obtained in a micromotion study. Such observational techniques as survey, farm records, or time and motion can be tailored to fit the problem. Several may be used in one study. Process analysis guides the collection and summarization of data according to defined stages. This facilitates the aggregation of segments of operations into different combinations and the description of

<sup>10</sup> Fellows, Frick, and Weeks, op. cit., pp. 11-12.

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technology applicable to each so that a desirable situation can be reproduced readily.

Many of the resources of farm-management research are used in the mechanical collection of data. This is also true for such subject-matter fields as agronomy and animal husbandry. Information from these fields ultimately enters into studies of farm organization. Too often the method used in summarizing these data makes them unsuitable for use in organization studies. Summaries of the total farm business, which are characteristic of many farm-record projects, provide an example of this short-coming.

Much of the value of process analysis stems from reducing processes into stages so that the data pertaining to them are additive and indentifiable with appropriate technology. General use of such a technique would greatly increase the value of data. But classification of activities so they can be recombined in different form is not peculiar to process analysis. Additivity is a basic assumption of linear programming studies, many of which are directed toward determining the farm organization that will give rise to some defined maximum. Examples of other methods of study that proceed on the basis of some functional classification are time and motion, and detailed cost studies.

Considerable space has been devoted to the problem of identifying and measuring differences in worker productivity that result from differences in method, effort, and skill. Conceptually, this is appropriate to an overall evaluation of process analysis, and limited use is made of this technique in some areas of agricultural research, particularly the processing and marketing areas, but accounting for these variables in quantitative terms at the farm level is difficult. Even when the tools for measurement have been refined, study of the actions of a worker engaged in the multitudinous tasks of general farming and study of a large number of persons performing highly repetitive activities in such an industrial setting as California pear processing will pose different problems. For farm or ganization studies, the immediate gains from having a more complete set of building blocks, or standards, even though rough, will be greater than from putting a fine polish on a few blocks, or standards. Studies of fam organization in Illinois, for example, would profit from the setting up of approximate labor inputs for dairying that would cover a range in size of herd and type of facilities. Very limited information on such inputs is now available.

Also, measurement difficulties are not confined to labor, as can be attested to by anyone who has tried to manipulate capital inputs, particularly multi-purpose items and those of a durable nature. Even on the output side, problems of measurement arise. New technologies commonly

result in both quantitative and qualitative changes in output. Quantitative changes are rather easily recognized, but variations in quality are more elusive. Control of quality so that the series of vertical dots in the cluster of observations referred to by Fellows actually represent a given output is a major problem in many studies of agricultural production. For example, consider the question of whether eggs washed by machine are the same product as eggs dry-cleaned by hand. Often, even the market is not prepared with an immediate and quantitative answer to the questions economists attempt to answer.

Long-run planning curves are set as the ultimate goal in Fellows' paper, but process analysis need not go to the extent of deriving long-run, or even short-run, cost curves (two terms which have a hazy meaning unless they are defined specifically) to be of value in studies of farm organization. Indeed, the knotty, sometimes almost insurmountable, problem of pricing inputs, particularly labor, can often be circumvented by keeping inputs in physical terms and setting up a maximizing problem on the basis of limitational factors. If analysis is extended to the formulation of long-run planning curves, it would be helpful to establish whether these curves apply to each stage, to sets of stages that may cover the production of a marketable product, to an enterprise, to a complete business, or to some other concept.

A discussion of process analysis is incomplete unless the wealth of descriptive information that is characteristic of this approach is emphasized. Other methods of study have been critized for determining optima but failing to provide a basis for reproducing the situations that give rise to the optima. Process analysis can provide the details needed in writing the recipe for placing the desired organization on a functioning basis. Admittedly, this facet of process analysis is largely in the sector of farm management viewed by some as farm operations. Even so, the division between organization and operation is often indistinct. Regardless of any such separation in the field of farm management, development of planning curves is of limited value unless information is available in a form that will permit reproduction of desired situations.

Some doubt remains as to whether, even under ideal conditions, process analysis solves the problem of parallels. First, the meaning of the term "problem of parallels" is not clear to me. If in this context it means the problem of keeping the fixed factors constant while comparing the productivities that result from different factor combinations—for example, holding the effects of labor constant while comparing the outputs that result from use of different machines—then process analysis should assist in the measurement and adjustment of labor to a constant input. But there appears to be little reason to expect this problem to be resolved

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ask why this is called the problem of parallels.

Whether the taking of data from existing operations brands a study as having "backward orientation" is problematic. Innovations can be appraised by many methods before use expands beyond the innovation stage. The Illinois station conducted a comprehensive study of field shelling and artificial drying of corn while fewer than one-half of 1 per cent of the farmers were using the method. For these few innovators, the results of such a study may be oriented backward and thus may be of restricted value, but for most farmers they provide a basic guide to planning future farm organization. Classification of an activity into stages aids such an analysis, but evaluation of new technology and synthesis of new systems do not depend upon process analysis alone.

For a restricted array of problems, process analysis helps to improve optimum, whether it is defined as a curve enveloping a series of minimum cost observations, as the average of the half of the workers who are most productive, as some maximum, or is stated simply as an increase in output for a given input. Process analysis should continue to grow in importance as a research tool for agricultural economists. It should also make an outstanding contribution to the organization of most types of studies.

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# SCIENTIFIC PROGRESS AND PROBLEMS OF AGRICULTURAL ADJUSTMENT

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### TECHNOLOGICAL CHANGE, FOOD NEEDS, AND AGGREGATE RESOURCE ADJUSTMENT

GLEN T. BARTON®
Agricultural Research Service, USDA

THE major purpose of this paper is to appraise the role of technology, especially in the problems of agricultural adjustment. The experience of the period since 1940 will be reviewed and attention will be given to long-run prospects for agriculture and the role that technology may play in the future.

Rapid technological advance has been a major factor in the large increase in farm output in the United States since 1940. With few exceptions, notably the years of World War II and the Korean conflict, farm production has tended to outrun growth in market demand for farm products. Because of the inelastic demand for farm products and the inability to adjust production resources quickly, serious adjustment problems have arisen in the postwar period.

### Sources of Increased Output Since 1940

The major sources of the greater output since 1940 have been related either directly or indirectly to technological developments. About one-fourth of the increase in output for human consumption during the World War II and postwar years, for example, was associated with the shift in kind of power used on farms. As tractors, motortrucks, and automobiles replaced horses and mules as a source of power, vast acreages of crop and pastureland and large amounts of labor and other resources were released from growing feed for maintenance of horses and mules for production of products for sale.

Since 1940, a large increase in crop production per acre has been the major source of greater output. Almost half of the increase in output came from this source. Greater use of commercial fertilizer was a chief factor in the step-up of farm production during World War II and the postwar

<sup>&</sup>lt;sup>e</sup> The opinions expressed in this paper are those of the author and do not necessarily represent the views of the Farm Economics Research Division, Agricultural Research Service, or the USDA.

<sup>&</sup>lt;sup>1</sup>This and following estimates of the quantitative importance of various sources of increased farm output are preliminary results of research by Donald D. Durost, Farm Economics Research Division, Agricultural Research Service, USDA.

years; probably it accounted for more than half the increase in crop production per acre and for nearly one-fourth of the addition to total farm output.

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Changes in acreage of cropland and in total consumption of pasture were nominal sources of greater farm output during the period. A greater volume of product added by livestock (product added in the conversion of feed into livestock and livestock products) also contributed significantly to the increase in output. It accounted for one-fourth of the additional output during World War II and the postwar years when the out-turn of feed grains and hay increased greatly and formed the basis for rapid expansion in livestock production.

Favorable weather aided the sharp upturn in farm output since 1940, but it is estimated that less than 10 per cent of the addition was due to this.

### Causes of Greater Output

United States agriculture entered World War II with a vast storehouse of available technical knowledge—the accumulation of results of many years of research effort. The technical basis for a marked increase in farm output existed during the interwar period but there was a lack of both risk capital and economic incentive for rapid adoption of improved production practices.

The educational reserves of United States agriculture upon entering World War II were important prerequisites for the upsurge in farm production. Farmers and farmworkers had increased significantly their average educational level, chiefly as a result of the long-time availability of the public school system in the United States. The federal-state extension service, which was initiated in 1914, also contributed to the educational reserve. During World War I and especially in the period following, extension workers had acquainted many farmers with newer and better production practices.

The extent and coverage of the extension service was expanded during the 1930's in connection with the initiation of various federal farm programs. The farm programs, in turn, added to the educational reserves of farmers regarding improved production practices. This was especially true of conservation practices and use of lime and fertilizer which were partly subsidized under the farm programs.

The highly developed marketing and transportation systems in the United States were also important prerequisites for the rapid expansion in farm output after 1940. The marketing system not only gave assurance to farmers that their products could be marketed quickly and efficiently, it also made possible rapid and timely movement to farms of fertilizer,

machinery, and other nonfarm goods that are important in modern commercial agriculture.

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The credit institutions that served farmers at the outbreak of World War II also fostered rapid expansion of farm production. Both public and private credit agencies were in position to provide promptly production loans to farmers.

Without these technical, educational, and institutional reserves, the marked increase in farm output after 1940 would not have been possible. These reserves were not built up in a short period; rather, they had accumulated over a long period of time and especially during the interwar period.

The sharp expansion in demand for farm products after the outbreak of World War II resulted in price relationships and farmer incomes that favored a rapid increase in farm production. In the years immediately preceding World War II, the parity ratio stood at about 80; by 1945-47, it had risen to 112. Prices received for crops rose greatly relative to prices of fertilizer. This was a chief factor in the marked increase in use of commercial fertilizer during the period. Farm machinery became increasingly "cheap" relative to labor during the World War II and postwar period. Loss of workers to nonfarm employment and the armed forces, together with rising farm wage rates, provided powerful incentives for further mechanization of agriculture.

Improved seeds, pesticides, formula feeds, and other production supplies, which proved to be key factors in the upsurge of farm output, were good "buys" for farmers in the same sense that fertilizer was a good buy. The increase in farmers' cash incomes provided an important means of financing the investments needed in expanding the productive capacity of agriculture.

The decrease in farm employment plus the rapid expansion in mechanization helped to bring about important structural changes in agriculture. Commerical farms decreased in number and increased significantly in average size. This development probably added to farm output as the relatively more aggressive and progressive farmers gained control of a greater proportion of farm resources.

Despite a lessening of over-all economic incentive, farm output has continued to expand during the 1950's. The parity ratio in 1955-57, for example, was 83 compared with 112 in 1945-47. Even with lower relative prices, it is still profitable for individual farmers to adopt improved production practices and increase farm output. For example, an individual farmer may have received from \$6 to \$8 of additional return for each extra dollar spent for fertilizer during the war and immediate postwar years, but by 1957 he received only \$3 additional return. The lower ratio is still highly

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profitable. Similarly, additional expenditures for pesticides, improved seeds, formula feeds, and additions to land area of a going farm mean additional output at marginal costs below prospective prices of farm products to individual farmers. These opportunities for lowering marginal unit costs of production on going farms continue to provide strong economic incentives for additions to volume of farm output per farm and in the aggregate. But with the inelastic demand for farm products, farm prices and incomes will be lowered greatly if increases in aggregate output exceed growth in market demand.

### Resource Adjustments

The large increase in farm production in the United States following 1940 was accompanied by marked adjustments in production resources. Acreage of cropland used for crops in the country as a whole changed little from 1938-40 to 1955-57. But man-hours of farm labor decreased by nearly a third and use of nonfarm inputs in agriculture expanded sharply. Use of commerical fertilizer in 1955-57 was nearly four times as great as in 1938-40. The number of tractors on farms tripled. Other nonfarm inputs such as pesticides, formula feeds, and so on, became increasingly important items in the farm production process.

The increase in nonfarm inputs more than offset the decrease in farm labor used. Total inputs in agriculture rose by about 5 per cent from just before World War II to the immediate postwar years, and a rise of 10 to 15 per cent in output per unit of total inputs was recorded.<sup>2</sup>

The quantity of total inputs used in agriculture continued to increase in the later postwar years. This occurred in the face of declining farm income and a lessening of the economic incentives that prevailed during World War II and the immediate postwar years.

The average annual increase in farm output, total inputs, and output per unit of inputs from 1945-47 to 1956 was less than during the period 1938-40 to 1945-47. However, the increase in production during the later period exceeded the growth in market demand, and farm income and resource-adjustment problems developed.

Several important attempts at resource adjustments were made. Government programs of acreage allotments and the soil bank attempted to adjust farm output to market demand mainly through reduction of land devoted to crops in surplus production. Some important decreases in pro-

<sup>&</sup>lt;sup>2</sup> This estimate and those estimates that follow are preliminary results of research by Ralph A. Loomis, Farm Economics Research Division, Agricultural Research Service, USDA, on measurement and analysis of change in total production inputs and in over-all productivity of agriculture. All conventional production inputs are included in the measurement of total inputs.

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duction of allotment crops were achieved. This is especially true when one contemplates what production might have been had we not had some kind of production control. But two major factors prevented these programs from achieving a significant reduction in total farm output. First, much of the acreage taken out of allotment crops was planted to nonallotment crops, chiefly feed grains. Second, as nonfarm inputs such as fertilizer could be readily substituted for land, yields of allotment crops were further increased, thereby offsetting at least partially the effects of reduced acreage.

The most significant adjustment in farm production resources since 1940 has been the rapid transfer of labor out of agriculture. Both man-hours used and farm employment decreased by 10 per cent from 1938-40 to 1945-47. The adjustment in labor resources was even more rapid from 1945-47 to 1955-57. Man-hour inputs and employment each dropped by about one-fourth during this period when economic conditions in agriculture declined, but attractive nonfarm job opportunities generally continued to be available.

The unprecedented shift in labor resources became evident in another way. About 28 per cent of all farm operators worked 100 days or more off their farms in 1954. This was about twice the percentage doing 100 days or more of off-farm work in 1939.

Nonfarm inputs, especially mechanical power and machinery, were readily substituted for farm labor. As a result, the sharp decline in farm labor input did not bring about a decrease in farm output.

### Longer-Run Needs and Production Potential

Demand for farm products in the United States continues to increase chiefly as a result of further growth in population. Total population of the United States may reach 230 million by 1975, or 37 per cent more than in 1956. With a projected rise in consumer incomes, farm output needs for the larger population by 1975 may be 35 to 45 per cent above the record farm output actually attained in 1956.<sup>3</sup>

With such a large longer run demand growth in prospect, the question arises, "Are we likely soon to eat our way out of the current adjustment problems in agriculture?"

Barring an unforeseen spurt in demand because of war or other emergency, the answer is a strong "no" for the years immediately ahead. There is little room for argument on this conclusion. The annual volume of farm

<sup>&</sup>lt;sup>a</sup> See Rex F. Daly, "Prospective Demands for Food and Fiber," *Policy for Commercial Agriculture—Its Relation to Economic Growth and Stability*, Joint Economic Committee, U. S. Congress, November 22, 1957.

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output has exceeded annual market requirements by perhaps 5 to 8 per cent in each of the last several years. The total volume of farm output in 1957 was about as great as that likely to be needed four or five years hence. However, the excess production in 1957 was concentrated largely in feed grains and wheat, and significant adjustments in composition of output would be needed. Also, orderly liquidation of accumulated surplus stocks could provide part of our output needs during the next few years. In addition, our present store of technology provides the basis for further significant increases in crop yields.

The answer to the question for the longer run period ahead is less certain. Judged by past experience, the over-all size of the production job ahead is large. The average annual increase needed in farm output from 1956 to 1975 will be about as large as that recorded during World War II and the immediate postwar years and more than double the long-term

annual increase since 1910.

A major source of additional output in the past is nonrepetitive and will be a nominal factor in increasing farm output in the years ahead. The shift from animal power to mechanical power in United States agriculture is almost completed. In addition, the contribution of favorable weather to greater output during the decade and a half following 1940 cannot be counted on as a source of further increase for the longer run period ahead. Thus pressure on other sources of additional output will be greater than in the past.

Some net addition to the cropland base is in prospect. About 30 million acres of new cropland would be added if public programs and related farm improvements should go forward at about the same rate as since 1945.4 This would represent little more than a 5 per cent addition to the cropland-equivalent base. Hence, further technological developments are likely to be the major means of meeting longer-run needs for farm prod-

In his analysis of future requirements for farm products, Bressler concludes that 1975 needs can be met only by continuing and substantial contributions in agricultural research and extension activities.<sup>5</sup> He thus implies that we are likely to "eat our way out" of major adjustment problems well before 1975. My own appraisal is that adjustment problems may continue to plague agriculture for a much longer period than is implied in Bressler's analysis. As I shall indicate later, the disagreement hinges

See Hugh H. Wooten and James R. Anderson, "Agricultural Land Resources in the United States-With Special Reference to Present and Potential Cropland and Pasture," Agricultural Information Bulletin 140, USDA, June, 1945.

<sup>5</sup> Bressler, R. G., Jr., "Farm Technology and the Race With Population," Journal of Farm Economics, November, 1957, pp. 849-864.

chiefly on differences in estimates of the size of the present technological reserve.<sup>6</sup>

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Although I make no attempt here to appraise our present educational and institutional reserves and our ability to add to them as needed, we have some evidence that they will not be seriously limiting factors in meeting longer run production needs. Certain phases of research work on longer-run production potentials underway in the United States Department of Agriculture have as their chief focus an appraisal of present technical reserves. Major effort is being devoted to the projection of crop yields attainable by 1975 from greater use of presently known technology. Natural scientists of the Beltsville Station, Agricultural Research Service, are cooperating with agricultural economists in making these projections.

Two types of yield projection were made, by states, for each major crop. The "economic maximum" yield was projected first. This is an estimate of the state average yield that would result if all farmers adopted presently known production practices up to the point that it would pay under specified economic assumptions consistent with a high employment economy. This estimate of yield assumed no limitations on management and no influence of other factors that might retard the rate of adoption of improved practices.

The second type of projection was the 1975 "economic attainable yield." In making this projection, management limitations and other factors that affect the rate of adoption of production practices were considered. This second projection represents the average yield farmers could attain by 1975 through greater use of presently known production practices.

The results of the yield projections indicate that a considerable technical reserve exists. Increases in yields averaging 35 to 40 per cent above those of 1951-53 appear to be attainable by 1975 from greater use of the technology now known.<sup>8</sup>

<sup>&</sup>lt;sup>6</sup>There is no question of the desirability of continued emphasis on agricultural research and extension activities. Research and education have made possible our long-time gains in production efficiency in agriculture and thus have contributed greatly to the rise in level of living in the United States.

<sup>&</sup>lt;sup>7</sup> Robert O. Rogers and Glen T. Barton are taking leadership in this research for the Farm Economics Research Division, Agricultural Research Service.

<sup>\*</sup>Because of limitations in available data and in methods used, the results of the study do not furnish positive proof of the existence of a large technical reserve. The projections of economic maximum yields were judgment estimates based chiefly on recently available experimental results. Few of the experiments were designed to measure yield potentials from combinations of known improved practices. The projections of economic attainable yields were based on judgments of the rate of adoption of improved practices. More adequate experimental data and improved techniques for projecting the rate of adoption of technology are needed in order to obtain more accurate appraisals of our technical reserves.

In essence, the study was a well-organized attempt, within the limitations of re-

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Another study being made in cooperation with Beltsville scientists projects potential increases in production per animal and in efficiency of feed conversion by livestock. The general framework of assumptions and methodology are the same as those used in the projections of crop yields.

Preliminary results of the latter study indicate that an average increase of about 10 per cent in efficiency of feed conversion by livestock may be attainable by 1975. This also indicates the existence of a significant technical reserve, as the bulk of the acreage of crop and pastureland in the United States is devoted to production of livestock feed.

The moderate net increase in the cropland base projected, plus the production attainable from the technical reserves noted, would about make it possible to meet the requirements for farm products projected for 1975 without the benefit of any additional technological discoveries. Major adjustments in crop acreage and production would be necessary, however. A shifting of resources to greater production of hay and pasture would be especially needed.

The approximate balance between production potential and projected requirements for 1975 is based chiefly on presently known technology. A net addition to the store of technical knowledge by 1975 is highly probable. Thus adjustment problems are likely to continue to confront United States agriculture over the longer-run period ahead.

### Prospective Resource Adjustments

Many of the trends in resource use underway since 1940 are likely to continue between now and 1975. Relatively little change in the cropland base is likely. A further decrease in farm labor inputs and in numbers of farmworkers can be expected also. Accompanying this will be a continued trend to fewer but larger commercial farms.

Further substantial increases in quantity of nonfarm inputs used in agriculture are in prospect by 1975. Greater use of fertilizer, for example, is likely to continue as a significant source of increase in crop yields. As in the last decade and a half, nonfarm inputs will continue to be substituted readily for both farmland and farm labor.

The quantity of total production resources devoted to agriculture appears to be greater than can be justified in view of the current levels of output per unit of total inputs and of market demand. An increase in total resources used in agriculture may be needed by 1975, however.

search resources available, to summarize the best available knowledge regarding yield potentials. Although judgment was involved in making the projections, the results of the study perhaps provide the most reliable evidence available. In the writer's opinion, the projections of attainable increases in yields from greater use of presently known technology probably are conservative.

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If the trend in output per unit of total inputs since about 1940 continues, attainment of projected farm production needs in 1975 would require perhaps 15 to 20 per cent more total inputs in agriculture than in 1956. But discovery and application in farming of substantial amounts of new technology during the next 20 years would lower the need for additions to total inputs.

The need for an increase in total resources in agriculture, under the productivity assumption made, would come in the latter part of the 1956-75 period. The desirability of reducing total inputs as a means of adjusting production to market demand will probably continue during the intermediate period ahead. Prospects for relatively slow growth in demand for farm production, the current situation of surplus production, the ample technical, educational, and institutional reserves available, plus the continuing economic incentive to individual farmers for increasing output lead to the latter conclusion.

Thus we are not soon likely to "eat our way out" of current adjustment problems. Rather, problems of production and resource adjustment may continue for many years to come as a major challenge to research workers, policymakers, and others concerned with the welfare of agriculture.

### DISCUSSION: TECHNOLOGICAL CHANGE, FOOD NEEDS, AND AGGREGATE RESOURCE ADJUSTMENT

W. E. HAVILAND AND M. E. ANDAL

Royal Commission on Price Spreads of Food Products, and Canada Department of Agriculture

Barton's important message is that food production in the United States is likely to continue to outrun the demand for many years. He develops this point, particularly on the supply side, thoroughly and effectively. No one can be certain about the future, but this suggests that downward pressure on farm prices and incomes is not only possible but probable.

There are other prominent U.S. economists who share this view, although when it comes to policy inferences the economists strike out in several ways.¹ Barton does not develop the policy implications of his conclusion, but that was not his present assignment—nor ours. Nevertheless, devising an appropriate and acceptable policy program is a more important, and more difficult problem. We will attempt a brief parallel presentation for Canadian agriculture.

<sup>&</sup>lt;sup>1</sup>Recent evidence of this can be found in Agricultural Adjustment Problems in a Growing Economy. ed. E. O. Heady, H. G. Diesslin, H. R. Jensen and G. L. Johnson, Ames: Iowa State College Press, 1958; and Willard W. Cochrane, Farm Prices Myth and Reality, St. Paul: University of Minnesota Press, 1958.

We do not have as recent comparable research as Barton had upon which to base our presentation, but we do have the systematic study of Canadian agriculture conducted two years ago by the Royal Commission on Canada's Economic Prospects.<sup>2</sup>

### Origins of Increased Output

In our brief discussion of the origins of increased agricultural output in Canada we will not attempt to draw the deft distinction, as Barton did, between "sources" and "causes" of increased output. The general increase in Canada's agricultural production of recent decades has been most prominent since 1939. Much of this increase in output came about through the application of more capital to a slowly expanding land base—in short, a mechanical revolution. Much farm labor was released and replaced in the process. Important regional shifts in production also took place.

The Royal Commission volume says that in the last 15 years farm productivity improved "at an astonishing rate", and confidently expects more in the future from the wider application of existing improved techniques.

In Canadian agriculture the greatest gains per acre have been made in the more intensive types of farming. In cereal production on the prairies marked gains have been made in output per man, but not per acre. Just by the application of fertilizer, large increases could be made in grain production in the northerly parts of the prairie farm economy. Impressive gains have been made elsewhere in Canada in the yields per acre of grains as well as some other field crops but much more could readily be accomplished. You in the United States are often well ahead of us. For example, your potato yields are 30 to 40 bushels per acre greater than ours.

Not too much concern has yet been shown by Canadian farmers for pasture rotations, the use of quality seed, or controlled grazing, not to mention fertilizing and irrigating pastures.

There is reason to hope for an improved farm credit program in this country that will facilitate farming adjustments—adjustments in methods, in machines, in management, in markets, and in agriculture's relationship to the rest of the economy. There is a growing awareness of the benefits to be gained from the use of more capital.

Formal agricultural education and extension services will no doubt also make an increasing contribution to our agricultural output, but we do not seem to have this mobilized as elaborately as in the U.S.

<sup>a</sup> Ibid., p. 80.

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<sup>&</sup>lt;sup>2</sup> W. M. Drummond and W. Mackenzie, *Progress and Prospects of Canadian Agriculture*, Ottawa: Queen's Printer, particularly Chapters 2, 4 and 5.

### Structural Adjustments

In the last two decades total physical capital per farm in Canada has increased, on the average, by about 30 per cent. The average investment in farms is much higher in the prairies, Ontario and British Columbia than in Quebec and the Atlantic provinces. Although the farm is becoming larger in area, land and buildings represent a diminishing proportion of the total investment. Investments in machinery and livestock on the other hand are of increasing importance. Physical real estate per farm has increased by about 15 per cent during the last 20 years, livestock by a little more than 30 per cent, machinery and power by about 94 per cent. Greater machinery investment has been most prominent in western Canada, whereas greater livestock investment has been more conspicuous in eastern Canada.

The ever-increasing investment in farms has the effect of making it more and more difficult to establish new farms. On the other hand, the effect of the growing importance of movable assets like machinery and livestock may be to increase the mobility of farm people, both inter-farm and out-of-farm mobility.

Improvements in farming practices and technology have resulted in larger farm output, not only in total but also in relation to capital inputs. In general, output per man has been increasing faster than output per acre and per unit of capital. Output per man has nearly doubled since the pre-World War II period.

With the expected decline in the number of Canadian farms, and in farmland in eastern Canada, it is difficult to say what will happen to the grand total of capital in Canadian agriculture; but the rate of expansion will likely decrease. With mechanization, larger farms and a declining farm labor force, the amount of capital per farm and per farm person will continue to expand. With more scientific farming and an increased use of inputs supplied from off the farm, such as purchased feeds and fertilizers, output per unit of farm capital input will increase. Output per farm person will continue to increase prominently. The relative importance of machinery, livestock and ready cash will increase, while the relative importance of land and buildings declines.

Looking ahead to 1980, the Royal Commission volume had this to say about structural adjustments in Canadian agriculture:4

The analysis of prospective demand when interpreted in terms of production requirements seems to suggest that in the next 10 years a very moderate expansion is required in the output of Canadian agriculture.

Somewhat beyond 1965, however, the population of Canada will have ex-

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<sup>&#</sup>x27;Ibid., p. 109.

panded to an extent which will bring about a fuller use of the land in agriculture. An examination of land resources has led us to the conclusion that the expansion in production is unlikely to occur through a large expansion of the area in farms. . . . It is our contention that technological improvement applied to grassland farming and to the breeding and rearing of livestock, along with mechanical improvements in the feeding and handling of stock, can increase output per acre very substantially without raising costs very much.

It is extremely difficult to measure the influence or the result of the application of technical knowledge in agriculture. Even so, many techniques for raising output are already known and can be applied as soon as the demand for farm products is large enough to warrant their use. In considering the intensification of land use which we envisage in the latter part of the 25-year period, the only process which seems to us to suggest a rise in costs greater than the general rise in prices is that of beef production. The limiting factor in beef production is the provision of adequate grazing land and forage crops. . . .

#### Conclusion

Our brief discussion perhaps has accomplished one thing—to indicate that we draw a similar conclusion from similar evidence about Canadian agriculture as Barton has about the U.S. There are some neo-Malthusians in Canada, but we are not to be counted among them.

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### TECHNICAL CHANGE AND THE PROBLEM OF MANPOWER ADJUSTMENT

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WALTER B. GARVER

Agricultural Department, Chamber of Commerce of the United States

N THE last decade the United States has surged forward at virtually unprecedented rates of growth. Employment rose from 58 million in 1947 to 65 million in 1957. This raw figure, of course, covers up the manpower trend in agriculture with which this inquiry is intended to deal.

Nonagricultural employment increased by 18 per cent during the 10 year period, by nine million workers. During the same time, agricultural employment declined 20 per cent, or two million workers. This displacement was equal to slightly less than one-fourth of the increase in nonagricultural employment.

It would seem normal to expect a decline in the relative importance of agricultural employment during a period of economic progress. This, of course, springs from the relative income inelasticity of demand for farm products generally. As economic progress permits higher planes of living, the growth is in directions to satisfy wants and desires above the minimum essentials to subsistence.

But absolute declines in agricultural employment are another matter. They call for appraisal in terms of changes within the agricultural sector of the economy. That takes us into the realm of technological change. The layman is too often inclined to use "mechanization" and "technology" interchangeably. The substitution of machinery for hand labor, of other forms of energy for human energy, has of course characterized, more than anything else, the industrialization and economic growth of modern economies. But technology is something more than mechanization.

For purposes of this discussion technological changes are defined as revision in the systems or patterns by which resources are managed for economic ends, such revision being sufficiently adopted to give them general currency and widespread use. Included are revisions in patterns of ownership and transfer of resources, although these can be regarded as comcomitants or results of the revisions in resource management without doing violence to the concept.

Before exploring the relation of technological change to the problems of manpower adjustment, it is necessary to emphasize that the two are not a closed system of mutually reacting forces. Technology develops on a multitude of fronts of which manpower is only one. Similarly, we have manpower adjustment problems arising from causes unrelated to technology. For example, such demographic factors as differential birth and

mortality rates and the resulting differences in replacement rates create by themselves adjustment problems.

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In spite of this, it is obvious that technology and manpower developments have had a profound effect on each other. In some cases it is possible to tell which is cause and which effect, but in others the interaction is so tangled as to almost defy analysis. A brief look at the motivations of each may help to narrow the problem of evaluating the effect of technology on manpower adjustment.

Farm manpower has been changed by a combination of "pulling" forces and of "pushing" pressures, the net effect being the reduction we have already mentioned .Chronologically, the oldest push has been the fact that the farm population reproduction rates were and are in excess of replacement needs. The net flow of people from farms has been of long duration in U. S. history and interrupted briefly only by economic recession or depression in the nonfarm sector. In this context, push and pull are relative terms. In the case of this long-time trend to out-migration there was evidently both pushing and pulling, the push coming from pressure of low income on the farm, and the pull coming from relatively better opportunities in off-farm employment.

The most emphatic pull came during World War II when military service required wholesale removal of young people from farms. To the extent that farm technology has been motivated by the need for labor-saving techniques, this draft of workers into military service was probably the greatest single stimulant to farm technology, especially to mechanization.

In the postwar period the powerful pulling force was the booming economy, with labor shortages in many lines resulting in nonagricultural employment opportunities sufficiently attractive to check the return of military personnel to farms and to draw additional labor from farms.

To fill the resulting gaps from these causes, farmers turned increasingly to technology. I think we can say that in this case manpower changes stimulated technology. The widespread adoption of some technological changes has, however, left us with a situation in which unquestionably technology is operating to push manpower off farms.

Turning now to motivations of technological change, it seems to me that much of it in agriculture has borne little relation, at least initially, to the manpower problem or to labor-saving considerations as such. It has become customary to classify technology in two categories: "output-increasing" and "cost-saving." This distinction doubtless has usefulness for analytical purposes in getting at some of the changes in individual farm adjustment, but it has misled many people into identifying "cost-saving" changes almost entirely with labor-saving" techniques thus creating a manpower adjustment problem.

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In a competitive situation like farming these are both aimed at one thing—the enhancement of net income. Techniques to increase output are themselves often cost-reducing in the sense of lowering unit costs. Cost-saving techniques often end in output-increasing results, especially where the savings uncover opportunities for marginal returns in a resource other than the one "economized." There is often the possibility that in addition to reducing costs, the new technique itself may invite increased output in order to reduce unit cost of its use.

Some technological changes have been stimulated by natural conditions not directly related to either increase of the scale of output or reduction of costs. Corn Belt people well remember the wet springs of the early 1940's when farmers dependent on horsepower saw their neighbors running machinery with headlights 20 to 24 hours a day in order to get a full crop seeded when the soil finally became workable. This was a powerful stimulant to mechanization in that area at that time. The growth of sprinkler irrigation has also been heavily stimulated by the effort to equalize or offset weather variations.

Sprinkler irrigation also suggests another motivation of technological change. With control of water application new methods or patterns of fertilizer application became practical and were adopted. Thus some technology is brought about by linkage with other techniques.

A source of technological change very little related to cost-saving or output-increasing is the development of new inventions or new products and services that are tried by the curious who want to have the latest. Undoubtedly, there are cost and output implications and consequences from the adoption, but the point is that they do not enter into the decision initially.

Some of these changes are motivated by the personal desire to reduce the drudgery and burden of farm labor tasks. With the spread of electrification and the increase in mechanical power, many changes of this type were made. Remotely these could be thought of as "cost-reducing" since they reduce the toil of the farmer and his family. But they are not initially motivated by cost or output considerations in the economics of farmers' decisions. In spite of this, the consequence is often further change in the patterns of operation. The farmer now finds that he has labor and time and often capital equipment which could be put to productive use. This, then, motivates changes tending to increase output.

An important stimulus to technological change has come from federal farm programs during the past two decades. This is especially true of the acreage control programs. Finding themselves with directed acres, farmers had a land resource with a new margin. They tried and adopted techniques to put this resource to a productive use. This accelerated plant

breeding livestock management and soil amendment techniques. Moreover, manpower and capital resources were relatively idled by the diversion of acreage. Pressure for income put these to new uses, and induced also more intensive use on even the acres not diverted.

The results of all this technology in agriculture have been over-simplified and characterized (even by some of the policy-makers) as "rising labor productivity." This implies great change in the intrinsic capacity of labor as a factor. Many people use "productivity" freely without even suspecting that it is at best a tentative ratio used to approximate certain relationships.

Take a hypothetical case of one and one-half workers producing on 100 acres a total of 6,000 bushels of corn using a given set of machinery. At some later time only one worker produces on 120 acres a total of 9,000 bushels with the same machinery. Has the "productivity" of the machinery risen by 50 per cent? It is now handling only 20 per cent more acreage. Has the "productivity" of the land risen by 25 per cent? With no change in the fertility, the increase is most likely due to fertilizers and plant strains put into the soil, a sort of capital productivity.

Yet it is a common occurrence to sum up this kind of a situation by saying that the labor productivity has increased by 125 per cent (dividing the 9,000 bushels by 4,000, original "rate per man"). Of course, no responsible agricultural agency makes the mistake of calling this "labor productivity." It is usually designated as "production per man (per hour, or other

time unit)," or "output per man-hour," etc.

Human problems, human welfare and progress are, of course, the central core of concern with farm problems, including the consequences of technological change. Output ratios to labor input are of major significance in agricultural progress. But implications that the major changes in these relations are a measure of the change in the intrinsic productivity of labor can lead us astray on two scores. Probably no factor of production has much intrinsic productivity. It takes the combination of them to yield a product. These combinations are after all what we mean by technology. It also seems clear that such intrinsic productivity as a factor may have is subject to slow change. This includes labor.

Man's continued existence on the planet has been possible only because he learned to combine factors to get products many times greater than the sum of the individual factors working alone. Our progress is largely the story of how we have changed the combinations to vastly in-

crease the product.

Implications about labor productivity may lead us astray on two scores. The first is that technological change has led us rapidly from "labor" farming in the direction of "capital" farming. Much of our gain has been due to the application of capital. For example, in bulk physical terms and ad-

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justing for cost differences, we now use at least three times the machinery and equipment in farming that we did in 1940.

Two points are relevant in this connection. The first is that capital has its costs and imperative reasons for earning sufficient return to keep it intact and in sufficient supply to meet changing needs. It is important that we be realistic in ascribing accurately capital's contribution to increasing productivity. The second is that our farm policy and programming will be wiser and more constructive, especially in legislative quarters, if there is clearer recognition of the role of capital in our changing technology.

The second place where there is temptation to go astray by labeling our progress as increasing labor productivity is the tendency in some labor union and industrial circles to tie labor wage rates to rising output per man-hour. To the extent that all the gains are thus improperly credited to "labor productivity," the rest of society is precluded from sharing the benefits of our technology. This operates directly against farmers and the farm sector in its impact on the costs of production factors and on the farmer as a consumer.

Let us now turn to the effects of changing technology on labor requirements in agriculture and the problems of manpower adjustment raised by these effects.

Since 1940 we have had an increase in total farm output of 40 per cent. This has been accomplished in the presence of a decline of labor applied of 30 per cent (man-hours of labor used). Thus the output per man-hour has been doubled. Technology has, of course, had a varying impact on the different farm enterprises. Production of livestock and livestock products has increased substantially more than output of crops. Output per man-hour has been increased in both categories, but for the livestock enterprises the increase is a little over one-half as compared to the slightly more than double increase in crops. This reflects the greater application of technology to crops, up to the present time, than to the livestock enterprises.

In each of these changes in enterprises' labor requirements technology of one kind or another has had substantial effect. It has had varying impact depending upon the applicability of certain techniques to the different enterprises, and depending to a considerable extent also upon the differences in the tasks required by each.

In terms of production per man-hour the greatest strides have been made in the crops, particularly feed grains, food grains, and the oil crops, for each of which the man-hour production has tripled since 1940. For hay and forage crops, cotton and sugar crops the production per man-hour has doubled.

The increases in the livestock enterprises have been more modest. Even

Table 1. Changes in Labor Requirements on Farms: Man-Hours of Labor Used by Enterprises, U. S.

	Per cent change 1935–39 to 1955
Milk cows	-24
Other cattle	+64
Hogs	+27
Sheep and wool	-48
Poultry	+16
All productive livestock	- 5
Horses and mules	-80
All livestock	-17
Corn	-64
Feed grains other than corn	-28
Hay	-39
Wheat	-60
Food grains other than wheat	-53
Vegetables	-20
Fruits and nuts	- 6
Sugar crops	-49
Cotton	-50
Tobacco	+ 8
Oil crops	- 3
All crops	-39
All crops and livestock	-30

here the increases are of major significance. Man-hour output in meat animal enterprises rose more than one-third; in dairy enterprises more than one-half; and the rise in poultry was nearly two-thirds.

The geographic location of farm production has been materially modified by the changing technology. With a national increase in farm output of 40 per cent during the 16-year period, the increase by geographical

Table 2. Changes in Production per Man-Hour, by Enterprises 1939 to 1955

	Per cent	
All livestock	+ 54	
Meat animals	+ 19	
Milk cows	+ 57	
Poultry	+ 64	
All crops	+105	
Feed grains	+200	
Hay and forage	+103	
Food grains	+180	
Vegetables	+ 44	
Fruits and nuts	+ 14	
Sugar crops	+ 96	
Cotton	+113	
Tobacco	+ 37	
Oil crops	+231	
Farm output	+100	

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shar and Tl areas has ranged from 22 per cent in the Middle Atlantic states and 25 per cent in New England to 60 per cent or more in the West North Central, Mountain and Pacific states. In five regions the rate of increase in output and the man-hour production appear to be closely related. In the other four regions wide divergence is shown. (See table 3.)

The low increase in output and the relative figures on man-hour production in New England and the Middle Atlantic region appear to reflect the predominance of livestock enterprises in the regions where adoption of technology in these enterprises is relatively slow.

TABLE 3. CHANGES IN FARM OUTPUT, PRODUCTION PER MAN-HOUR, AND LABOR REQUIREMENTS

(	in	percentages	١
١.	***	percentenses	,

Region	Farm output	Production per man-hour	Labor requirements
New England	+25	+ 79	-30
Middle Atlantic	+22	+ 68	-32
E. No. Central	+39	+105	-32
W. No. Central	+63	+108	-30
So. Atlantic	+34	+ 77	-24
E. So. Central	+37	+101	-32
W. So. Central	+29	+125	-42
Mountain	+62	+100	-28
Pacific	+57	+ 70	- 7
United States	+40	+100	-30

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modi-

output phical The South Atlantic states show comparatively modest increase in production and below average rate of change in man-hour output. There has been also a much smaller rate of reduction in labor requirements in the area. This seems due to the fact that the region continues to have chronic surplus manpower problems. In spite of some increase in industrialization of the area, it remains a major problem area in manpower adjustment.

In contrast is the West South Centeral region where rapid industrial development has seemingly pulled people from farms, giving the region the largest ratio of reduction in farm labor requirements for the nation. Total farm output has expanded by only 29 per cent, but the region has the largest increase of any region in the nation in production per manhour.

In the Mountain states a large increase in output and a typical increase in man-hour production is associated with a reduction in labor requirements below the national average. Here it would appear there is a combination of expansion in the cattle enterprise, together with some of the sharp technological gains in crops in parts of the area, such as Arizona and Colorado.

The Pacific region shows a marked increase in farm output but

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an increase of only 70 per cent in production per man-hour, and the lowest reduction in labor requirements of any region. Net gains in population in the area have expanded the demand for farm products that can be marketed locally. Moreover, a substantial portion of the output in this area is from enterprises that thus far have lent themselves least to technological improvement.

What are the effects of technology on the kind of labor required on the farm? It seems to me that technological change is ambivalent in its effects on the degree of skill and training required. Some developments make tasks more complex and tend to require a higher degree of intelligence, knowledge and skill because they increase the variables and the chances for error. In other developments the technology has gone to a stage, especially in some cases of "packaged" technology, where a certain amount of simplification or specialization, or both, requires possibly less basic ability than previously.

This ambivalence would appear to explain two trends that appear evident. The first is the increasing emphasis that is required of the "management" aspects of farm manpower. The declining relative importance of hired labor suggests the influence of technology in making more labor tasks also management functions. The second is the rising trend in contract farming and vertical integration. This appears to be a transformation of technology in which the techniques have become sufficiently standardized and packaged so as to be handled in terms of simplified tasks according to formulae of one kind or another, removing from labor much of the management responsibility it otherwise carried.

The effect of technological change on seasonal labor requirements is not conclusive. Over the period from 1941 through 1957 there appears to be little change in the seasonal pattern based on U. S. Department of Labor measures of farm employment. Taking the average periods of 1941-45 and 1953-57 the seasonal index was at a low of 83-84 for January and a high of 118-120 for June in both periods. However, a year-to-year comparison of January low to June high variations, show that while January farm employment has consistently been in downward trend through out the entire period, the difference between the June high and January low (which is used here as a rough measure of seasonal peak requirements) showed a downward trend only until 1951, after which it has risen by more than 20 per cent. Expressing the seasonal labor requirements as represented by these differences as percentages of the January low level, the ratio averaged 45 per cent during 1941-45. For 1951-53 it was at its lowest level around 35 per cent. For 1954-57 it has averaged above 45 per cent, and appears to be rising.

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This would suggest that as technology is adapted and spreads, more of the labor requirements will be met by seasonal labor.

It is obvious to almost every student of the farm manpower problem that the decreasing farm labor requirements compel adjusting to other forms of employment. Technology in the nonfarm sectors has a marked bearing on this possibility. There is perhaps as much apprehension about technological effects on employment opportunities off the farm as there is with regard to farm labor employment. The concern over automation in many lines is only symptomatic.

Because so much emphasis has been put on "rurban" industrialization it may be appropriate to point out that if the trends of recent years are a dependable indication of the future, industry as such will claim a diminishing proportion of the labor force. In spite of this there are countless industrial lines, as well as other non-farm outlets for labor, in which expansion is expected to exceed growth in the labor force. In some of these the availability of sufficient qualified labor is presently a limiting factor on growth.

As technology has increased the industrial output of the nation, it has raised the standard of living and brought into rapid growth many service and professional lines which indicate increasing labor requirements for the immediate years ahead. Some of these service lines are the direct result of technology in consumer goods.

The picture is hard to focus, of course, because the nonfarm sectors are also in a high state of dynamic flux in relation to technology. There seems little reason to doubt that while opportunities for off-farm employment will increase, the wrenching and shifting within that part of the economy makes scheduling and defining of off-farm opportunities extremely difficult

Against this setting it is nevertheless clear that continued heavy migration from the farms will be imperative if present and future farm people are to improve their economic status. Some outlet will be found in the development of rural communities providing local off-farm employment or a combination of part-time farming with such employment. One aspect of farm technology is the trend toward services and facilities formerly supplied on the farm but now specialized as "rurban" businesses. The demand for labor on this account can be expected to increase.

How much can outmigration be counted on to improve the income of farm people? For those who do migrate to employment in which they are more productive economically, it would be expected, of course, that their incomes would be improved. As for the effect on remaining farm people, it seems to me that out-migration helps, at best, only to the extent that it

is substantial enough to raise the net marginal relative price of farm labor. This means more simply that it would need to proceed far enough so that the per capita income rate is substantially raised. There is reason to at least question whether outmigration can develop at a pace that will move ahead of technological changes that otherwise might tend to depress labor returns. Conversely, technology on the farm can be stimulated, as it has to a degree in the past, by a rise in relative farm labor returns.

There are unfortunately a number of serious impediments to the kind of migration that would look like a contribution toward raising low farm incomes. Acquiring the training and skills for the nonfarm jobs where opportunities are greatest is in itself a herculean task for many. Knowledge and information about opportunities would need to be made availa-

ble on a much more meaningful scale than exists today.

The sheer costs of moving home and family to a strange setting are insuperable for many. Severing home and community ties of long standing appears too tragic for many people. The insecurities and uncertainties about such a radical change is a forbidding prospect to many folks. Economic fluctuations, such as recessions, are a major deterrent. Yet it may be well to recall that in one year, from April 1954 to April 1955, 2 million workers moved from one state to another, and an additional 2 million moved from one county to another. Counting other members of the families, 10.4 million people made moves out of the county, of which 4.9 million were to a different state. This is a demonstration of mobility showing some remarkable ability to overcome the practical and "psychic" expense of major migration.

In summary, migration from the farm is imperative if incomes are to be raised, but the obstacles, if not barriers, to an effective rate are formidable. However, serious doubts about our collective ability to engineer the

removal of many of these obstacles exist.

But assuming a successful manpower adjustment, what would be the effects on the surplus problem in agriculture? Here pessimism and realism seem to go together. The surplus problem is primarily a relation of supply to demand in terms of a farm commodity price level. Our most acute surplus problems are in commodities for which it has been policy to stimulate and reward by price supports. It is doubtful whether enough labor can be pulled or pushed from farms to lower total farm output. With the technology still to be exploited in farming any buoyance to prices will speed output expansion. This is inherent in the highly competitive nature of the farm business. As long as there are farmers who will hang on at the margin, as long as there is capital that is freely invested in farm resources even at relatively low rates of return, as long as there

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are men who would rather be their own masters in farming than servants of someone else, I think we can not count on large-scale manpower adjustment to remove the problem of relative surpluses.

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## DISCUSSION: TECHNOLOGICAL CHANGE AND FARM MANPOWER ADJUSTMENT

GEORGE V. HAYTHORNE Department of Labour, Ottawa

Garver has brought out many of the important relationships between technological change and farm manpower in his paper. It is useful too, as he has done, to consider the meaning of technological change in this context. I agree with the broad interpretation he has used and also, in general, with his analysis of the motivations or reasons for technological changes taking place in agriculture.

There is one point in this analysis, however, about which I have some doubt. It is the emphasis placed on the shortage of farm labor during and after World War II as a factor encouraging widespread technological change in agriculture. A more significant consideration I feel, at least in Canada, at this time is the substantial increase in the demand for farm products. This led in turn to an increase in farm income which made the purchase of farm equipment and facilities possible on a larger scale.

I am glad Garver in his discussion of productivity warns us against the use of the rather loose expression "labor productivity." I think perhaps unintentionally he referred later to productivity as being something of an "intrinsic" quality of labor or other factors of production. We avoid enfusion and misunderstanding it seems to me if we use the term productivity in relation only to the ratio of input to output factors and to changes in this ratio as suggested by the International Labour Organization and other agencies. It is true that we frequently use man-hours, mandays or man-years as the denominator in this ratio but in doing so we must not assume that labor is the only, nor is it always the main, factor which has contributed to a change in productivity.

I found the discussion of the impact of technological change on labor requirements by types of agriculture and areas of United States both interesting and suggestive. Similar data are not immediately available for Canada, but I would expect the same broad patterns to prevail.

The only specific comment I shall make with regard to this part of the discussion is that I think we need not be surprised about the increase in farm wage rates since 1940 when we recall that the rates were very

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low in both United States and Canada at the beginning of World War II, that some of the skills required in farm work have increased, and that there has been a substantial increase in productivity.

With reference to the seasonal effects of technological change there has also been a rise in the amplitude of employment in Canadian agriculture as between the winter and summer months. With the secular decline in farm labor there are, of course, fewer workers affected by this change. On the other hand, a shortening in the length of the peak labor period during the summer appears to be occurring. This tends to increase some of the problems for farm workers, notably to increase their mobility and to reduce their employment security.

Manpower has been affected by important technological changes occurring outside as well as inside agriculture as Garver has pointed out. One of the most important of these affecting seasonal employment for Canadian farm workers during recent years is the greatly increased mechanization in the forest industries, including summer cutting. As a result it is harder for farm workers to secure employment in the fall and winter outside agriculture. This has posed added difficulties, particularly when farm workers are not covered by unemployment insurance. It also means that more consideration is needed, both of the possibilities of developing more year-round employment in agriculture, and of suitable joint or complementary occupations for farm workers.

Another problem which appears to have increased with the rapid advance of technological change is the frequency of farm accidents. The data on farm accidents are incomplete in Canada, but those that are available for farm fatalities indicate that over the past five years there have been on the average 12 deaths per 100,000 farm workers. This number compares with 10.6 on the average during the years 1934 to 1937 inclusive. In the United States during 1957 some 3,500 fatalities were reported in agriculture. The data are not strictly comparable between the two countries; however, this total does suggest a somewhat higher farm fatality rate in the United States than in Canada. Mechanization is not the only factor involved here even though it, no doubt, has some significance. In any event these data emphasize the need for greater attention in both Canada and the United States to farm safety and to workmen's compensation for people employed in agriculture who in most provinces and states are still unprotected by this legislation.

Near the end of his paper, Garver states that "continued heavy outmigration will be imperative if present and future farm people are to improve their economic status."

I fully agree with this conclusion, but the analysis of the problem of

technological change in relation to surplus manpower in agriculture must go deeper than the traditional marginal approach of economic theory.

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The fact is that technological change has been of benefit mainly to those who have been able to or who have decided to take advantage of it. In other words technological change passes many farmers by. This is true for a number of reasons. One of these is that for many farmers economic motives are by no means the only important motives for their being in or remaining in agriculture. For others, capital requirements are too high or farm credit is too poor. Others are too old and perhaps set in their ways. Here though I think there is some change taking place on the part of younger people in agriculture. They see the benefits of working shorter hours, although they do not always take full advantage of their leisure time. Still others are too isolated to take advantage of many of the technological improvements including, for example, rural electricity and convenient market roads. Others are living on farms which are too small or the general pattern of their farm organization is inadequate. There are others too, whose educational level is very low.

Barton spoke earlier this afternoon of the educational reserve in agriculture. I agree there is an educational reserve which may be higher in the United States than in Canada, but I think he will agree that this reserve could be much better than it is. In Canada, for example, at the time of our last decennial census in 1951, 76 per cent of the male farm workers had no more than eighth grade education. This is much higher than in manufacturing where the similar percentage was 54, while in trade it was 39 and in services 35. This rather strongly suggests the need for more attention to rural education and to the development of training facilities for farm youth suited to the technological (and other) changes taking place. The real question here is what to do about those people remaining in agriculture who, in their own interests as well as in those of their country, would be better employed and generally happier elsewhere. Garver doubts our "collective ability to engineer" the removal of many of the obstacles in the way of moving these people. I share some of his doubts, but perhaps we should be prepared to consider some new approaches.

We have developed incentives in other aspects of agriculture. In fact some people would say that the farm commodity surpluses we have today are in part a result of these incentives. Be that as it may, I think we can assume that many of these incentives will remain. This poses the question: Are there socially desirable incentives which can be developed to encourage surplus or underemployed farm manpower to move elsewhere?

If incentives can be found to help inefficient producers in agriculture

become efficient producers elsewhere they will be able to take advantage for themselves and their families of technological changes and improved standards and be in a better position to contribute to their communities and to their country. Also, to the extent that they move out of agriculture they will help to increase a market for farm products. Admittedly it is difficult to develop suitable incentives in this area which is more directly related to the human factor in agriculture. The responses are delicate but this is not a sound reason for neglecting the problems involved. These problems and their solutions require careful attention and research rather than being largely ignored as they have been in the past.

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### SCIENTIFIC PROGRESS IN AGRICULTURE, LAND REQUIREMENTS AND LAND USE ADJUSTMENTS

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HOWARD W. OTTOSON AND A. W. EPP\* University of Nebraska

CIENTIFIC progress may be thought of as the sum total of all the various technological developments from the beginning of time, particularly those which have characterized western civilization since the early 1800s, and which have enhanced the abilities of factors to produce goods and services. This is called progress because we apparently prefer more to less. The introduction of technologies, however, disturbs the relationships between factors, between products, and between factors and products, and hence calls for re-examination of the way in which these factors will be combined. Today we examine particularly the impact of scientific progress on the land factor.

First let us examine the nature of scientific progress in agriculture, then trace the more interesting contemporary facts about scientific progress in agriculture particularly with respect to land use before conjecturing about the future.

### Scientific Progress and Land Use

In agriculture scientific progress may occur in two ways in terms of production functions. First, it may be a more optimum level of application of a given variable input to fixed inputs, under given price-cost conditions. Second, it may involve the discovery and adoption of a new input, and consequently a new output function for a given schedule of resource inputs, or conversely the lowering of cost functions for a given schedule of outputs. This is termed innovation.

Considerable attention has been given to changing input-output relations underlying scientific progress in agriculture, with an increase of our understanding of them. There is evidence that our accounting of inputs in relation to increases in output has been inadequate, particularly relative to qualitative differences, and improvement, in the labor factor and in management.1

<sup>\*</sup> The comments of John Muehlbeier, Don Kanel and T. S. Thorfinnson have been

The comments of John Muchibeler, Don Kanel and T. S. Thornmish have been very helpful in the preparation of this paper.

1 T. W. Schultz, "Reflections on Agricultural Production, Output and Supply," Journal of Farm Economics, August, 1956, pp. 748-62; "Alternative Diagnosis of the Farm Problem," Journal of Farm Economics, December, 1956, pp. 1137-52. Also: Zvi Griliches, "Specification Bias in Estimates of Production Functions," Journal of Farm Economics, February, 1957, pp. 8-20. Heady has since presented a logical argument as to why it has been possible for output to increase faster than inputs in

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Much of the educational work in agriculture has dealt with the possibilities of using increased quanities of specific variable inputs like fertilizer on land, or grain with dairy cows, or different resource combinations, as for example, combinations of protein feeds and grain in the livestock ration. The assumption back of these efforts has been that these changes were economic, as in most cases they probably have been. Their effect has been, in the main, output increasing. There is no reason, of course, why some adjustments might not also involve the changed use of a resource, or a shift in a product combination.

As Heady points out, the distinction between innovations is of importance mainly at the firm level, since in the aggregate they make possible the production of greater output from the total stock of resources.<sup>2</sup>

The output and cost increasing innovations such as fertilizer, weed spray, insect sprays, more efficient plant varieties, disease control, have the effect of directly increasing the production potential from a given land base. With crop prices constant, the marginal revenue productivities for all resources will be increased by the introduction of these technologies, giving us greater production on the same acreage with an increase in total income, as well as costs (the case of a shift of both demand and supply curves to the right). It is conceivable that labor and capital could be substituted for land with no increase in total production. But the more likely adjustment is the increase in nonland resources, land fixed, or the substitution of one nonland resource for another, with an increase in total production. This type of innovation will provide the major base for future production potential for additional food when it is needed.

The type of innovations which decrease costs while leaving output constant typically increase the marginal productivity of capital and provide the incentive for the substitution of capital for labor. This type of innovation may enable a farmer to "cover more acres," in order to either achieve a lower capital cost per unit of output or to more fully employ his labor, as well as to increase his income. The final effect of these adjustments may be the use of greater quantities of capital and land per farm and less labor per unit of output.

This type of innovation puts pressure on the development of additional

agriculture. See Earl O. Heady, "Output in Relation to Input in the Agricultural Industry," Journal of Farm Economics, May, 1958, pp. 393-405. Stout and Ruttan have made an interesting analysis which indicates that regional differences in the growth of output in relation to inputs in agriculture have not been as great as sometimes suggested: See Thomas Stout and Vernon W. Ruttan, "Technological Change in American Agriculture." Journal of Farm Economics. May, 1958, pp. 196-207.

American Agriculture," Journal of Farm Economics, May, 1958, pp. 196-207.

<sup>2</sup> See Earl O. Heady, "Basic Economic and Welfare Aspects of Farm Technological Advance," Journal of Farm Economics, May, 1949, pp. 243-316; and Thomas T. Stout and Vernon Ruttan, "Regional Patterns of Technological Change in American Agriculture," Journal of Farm Economics, May, 1958, pp. 196-207.

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land, if it is available at an acquisition cost less than its marginal productivity. Presumably the marginal productivity of land is raised in the reorganization of factors attendant with the innovation. In the absence of additional available land, it would simply add pressure to the tendency toward increased farm size, releasing labor resources to other industry.

The general economic effect of the ouput increases associated with scientific progress on farmers depends upon the elasticity of demand for the products. Assuming inelasticity of demand, changes which increase agricultural production will decrease gross income to agriculture; if total costs are increased, net income will also be decreased. Changes which do not change output but which decrease costs will increase net income.

## Technological Changes in Agriculture

Since 1940 crop production per acre has increased by 20 per cent and total farm production has increased by one-third in the United States. With a decrease of 33 per cent in man hours worked between 1940 and 1957, the output per hour in American agriculture doubled. Since 1925-27 the average output per unit of aggregate input in U. S. Agriculture has increased by 55 per cent.<sup>3</sup>

Total production of both livestock and crops has continued to increase during the period since 1940. Since 1950 the increase has been more rapid in livestock, partly due to the cyclical buildup of the beef numbers. During this time inputs of machinery and fertilizer have replaced labor, while cropland has remained very constant.

#### The Land Base

In the continental United States are included 1,904 million acres of land, of which 1,158 million acres were in farms in 1954. The breakdown of land by use in 1954 was as follows:

	(Millions of acres)
Cropland (including that used only for pasture)	478
Pasture and grazing Land	930
Forest and woodland not pasture or grazed	300
Special use acres-cities, highways, parks, etc.	110
Miscellaneous	86
	-
Total	1,904

Cropland includes land used for crops, 387 million acres; land used only for pasture, 69 million acres; and land used for soil improvement

<sup>&</sup>lt;sup>3</sup> Thomas Stout and Vernon Ruttan, op. cit.

<sup>&#</sup>x27;See Hugh H. Wooten and James R. Anderson, Agricultural Land Resources in the United States, USDA Agricultural Information Bulletin, Number 140, 1955.

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and idle land, 22 million acres. From 1880 to 1920 the acreage of cropland harvested was more than doubled, but it has been very stable since World War I. Land development has been offset by development of urban areas, roads, and other nonfarm uses. More than half of the total acreage of cropland is in 11 Corn Belt and Great Plains states.

What are the possibilities for bringing additional land into production? It is estimated by the U.S. Department of Agriculture that a net addition of 30 million acres (6.3 per cent) will be made to new cropland by 1975. This estimate assumes that present land development projects, including irrigating of raw land, drainage, flood control, and land clearing are carried forward, and that new development projects are carried on at the present rate. Also assumed are the withdrawals of land for highways, urban and industrial growth, roads, airports, and reservoirs. About 40 million acres of new land will be developed by 1975, but about 10 million acres of crop and pasture land will be taken out by withdrawals. With increased development of suburban areas and the new highway program, it is possible that the cropland withdrawn might be as much as 20 million acres.

It is also estimated that the equivalent of 14 million more acres (3 per cent of present cropland) in productive capacity will be added by irrigation development, drainage, and flood control projects on existing cropland. Thus, it would appear that the feasible supply of cropland by 1975 could be about 520 million acres.

The above does not represent the extreme potential as far as cropland is concerned. It appears that there are about 175 million acres of additional land in the U.S. which could be cropped if needed. It may not be economical to use it before 1975. However, if necessary under emergency conditions, the cropland supply could be raised to 600 million acres, and with more difficulty to 700 million acres.

The 930 acres of pasture and grazing land can be estimated as the equivalent of 150 million acres of cropland as far as agricultural productivity is concerned. Thus the potential productive plant, as far as crops are concerned, amounts to about 850 million acres of cropland equivalent. In terms of the 1950 acreage, the likely shifts of land to crops and development of existing acreage is equivalent to 7 per cent of the present crop production plant, including pasture. Our extreme potential represents a 36 per cent increase in crop acreage equivalent. However, it is very doubtful that a proportionate increase in production would result from shifts of this magnitude, as compared to that from the smaller shift of 7 per cent in crop equivalent, which seems likely.

<sup>&</sup>lt;sup>5</sup> Two-thirds of the increase will occur in the north central and southern regions, Wooten and Anderson, op. cit.

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Of course, it is necessary to distinguish between the physical and the economic supply of land. When homestead lands were opened up, the supply schedule was very elastic and the price low. Since then the supply of land for agriculture has become very inelastic, in terms of the services accruing for given additional investments in the land factor. Much of the available additional areas can be brought into production only by incurring substantial development costs; while these are not included in the asking price of the raw land, they are land alterations which become a necessary component of land before production can take place. Conversely, the alternatives with respect to other uses are largely limited.

Johnson has suggested rather interesting hypotheses concerning the stability of the use of land in agriculture. He suggests that an asset, like land, will be regarded as a fixed asset if its marginal value productivity is between its salvage value and acquisition cost. Further, the acquisition cost of land greatly exceeds its marginal value productivity, while its salvage value (to the industry) is zero, except in rural urban areas. Therefore, technological development in the United States will have no affect on the employment of the land resources, in the foreseeable future; neither will extremely low or high farm product prices.

We recognize the impact of scientific advance on uses competitive to agriculture for land. Certain uses, such as highways, mining, and urban developments, bid land away from agriculture with ease, almost without regard for its productivity in agriculture. However, the acreages involved are still relatively small. On the the other hand recreation seems to involve mostly land which is marginal for agriculture.

In view of the above, we can regard the total physical supply of land for agriculture as quite fixed, except for the current projections, dealing with uses within agriculture, rather than between agriculture and other

# Farm Product Use Projections

Daily estimates that the utilization of farm products per person will be about 110 per cent of the 1955 level by 1975, and that the population will increase 27 per cent to 210 million. The net effect of these two changes may be an increase in consumption of farm products of 40 per cent by 1975, as compared to 1955, or 52 per cent over 1950. Bonnen and

<sup>&</sup>lt;sup>6</sup>Glenn Johnson, "Supply Function—Some Facts and Notions," Agricultural Adjustment Problems in a Growing Economy, Edited by Heady, et. al., Ames: Iowa State College Press, 1958, pp. 74-93.

<sup>&</sup>lt;sup>†</sup>R. F. Daly, "The Long-run Demand for Farm Products," Agricultural Economics Research, Volume 8, Number 3, July, 1956, pp. 73-91. Collins and Mehren agree generally with these projections, under the assumptions made by Daly. See Norman Collins and George Mehren, "Demand Functions and Prospects," in Heady, et. al., op. cit., pp. 61-69. Also: R. G. Bressler, "Farm Technology and the Race with Population," Journal of Farm Ecomonics, November, 1957, pp. 849-864.

Cromarty estimate an increase in consumption between 1955 and 1965 of about 20 per cent, which is based on an estimated increase in population to 190 million by that time.8

The changes in demands likely to take place with respect to individual products are estimated with less impunity. However, the past trends indicate that per capita meat consumption, particularly beef and bacon type pork, will rise with increases in income. The crops affected will consequently be hay, pasture, and corn, as well as protein sources. Wheat, potatoes, and other cereals as well as cotton are likely to experience decreased per capita demands. Other products including dairy products, fats, vegetables and fruits will probably be quite stable per capita wise, with their total consumption related to population growth. Of course, these projections cannot be viewed as predictions, but they seem reasonable in terms of the assumptions concerning national productivity, population, and continued peace upon which they are based. With them we can examine some of the evidence concerning the aggregate productive ability of American agriculture to meet these projected needs.

## Aggregate Production Potentials

It is instructive to evaluate the results of the USDA production capacity study of 1950 in comparison to what actually happened during the period in question. A comparison is made in Table 1.

The differences in the assumptions underlying these estimates and

TABLE 1. COMPARISON OF CHANGES IN AGRICULTURAL PRODUCTION CAPACITY ESTIMATED AS ATTAINABLE IN 1955 WITH ACTUAL DATA FOR 1955, UNITED STATES

Changes in:	1955 Estimated Attainable <sup>a</sup>	1955 Results <sup>t</sup>	
	Per cent <sup>c</sup>	Per cent	
Total farm output	20.6	10.4	
Crop production	20.5	8.6	
Crop production Livestock production	19.5	12.5	
Cropland used for crops	3.0	-11	
Cropland used for crops Crop production per acre	17.2	9	
Fertilizer use	69.4	26	

\* Based on Agriculture's capacity to produce, USDA Agricultural Information Bulletin,

From Agricultural Outlook, 1958, USDA; and Agricultural Handbook Number 91, USDA.
 All percentages not indicated as negative are increases.

<sup>8</sup> Measuring the Supply and Utilization of Farm Commodities, Agricultural Handbook Number 91, Agricultural Marketing Service, USDA, November, 1955. Net utilization includes domestic food and nonfood use and commercial exports, but excludes seed and feed used for production. James T. Bonnen and William A. Cromarty, "Structure of Agriculture," in Heady, et. al., op. cit., p. 125. Their estimates are similar to those of Collins and Mehren under two different assumptions with respect to population levels.

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the actual conditions which occurred, as well as estimation errors, explain at least some of the differences in the two sets of data. The capacity data were defense oriented and assumed a parity ratio of 105. Actually the parity ratio had fallen to 84 by 1955, and drought had affected some of the country. Despite this, total farm output had been increased by 10 per cent with a decrease of 4 per cent in the farm labor force and 11 per cent in acres of land used for crops. The decrease in cropland alone between 1950 and 1955 can account for the difference between the attainable and actual levels. In other words, about one-fifth of the estimated increase in production estimated for 1975 had actually been met by 1955. Continued growth at the rate represented by that five year period would accomplish the increase estimated necessary for 1975. Further, the productive capacity figures specify the conditions thought necessary for achieving two-fifths of the 50 per cent increase in consumption projected for 1975 by Daly.

The role of fertilizer in the estimates of productive capacity, and in the actual results is worthy of note. Although fertilizer use increased by 26 per cent from 1950 to 1955, it appears that the possibilities represented by this resource have not yet been exploited. By using other data prepared in connection with the capacity study it is possible to conjecture further as to crop production capability in the United States. In Table 2 are given the estimated increases in crop production of selected crops associated with fertilizer use at (1) double 1950 levels; (2) triple 1950 levels, and (3) at the potential yield with full fertilization according to experi-

Table 2. Estimated Changes in Crop Production under Several Changes in Fertilizer Use<sup>a</sup>

Crop	Unit 1950 Production		Added production		
		Double 1950 rate of fertilization	Triple 1950 rate of fertilization	Full fertilization use at rates recom- mended by exper- iment stations	
			1000 units		
Corn	bu.	2,831,004	582,900	1,056,857	2,289,851
Wheat	bu.	734,253	99,118	164,396	697,484
Oats	bu.	1,276,806	150,996	277,790	920,980
Peanuts	lb.	1,998,200	179,838	319,712	856,380
Cotton	lb.	4,188,000	562,360	1,198,240	5,525,000
Hay	ton	85,209	9,188	15,891	111,364
Potatoes	bu.	288,841	118,270	176,449	189,910

\* Based on fertilizer use and crop yields in the United States, USDA Handbook No. 68, 1954.

<sup>&</sup>lt;sup>1</sup> Fertilizer Use and Crop Yields in the United States, USDA Agricultural Handbook Number 68.

ment station recommendations. A rate double that of 1950 on selected crops would involve a total of \$1,775,000,000 worth of fertilizer, or \$806,000,000 more than in 1950. (Vegetables, fruits, and pasture are not included). The increased crop production of 2.2 billion in 1950 dollars would require 36 cents worth of fertilizer per dollar of output, (marginal return of \$2.78 per dollar of fertilizer). At the "triple" rate of 1950 the cost per dollar of additional output over the double rate would be 47 cents, equivalent to a marginal return of \$2.13 per dollar of fertilizer. The total increment of crop production would be 1.7 billion over the "double" rate. No input data are available for the "full" fertilization level, but would, of course, involve an even higher marginal cost per dollar output. The increment of crop production would be 7 billion dollars over the triple 1950 rate, or a total of 11 billion dollars increase over the 1950 level.

The South would experience the greatest percentage and absolute increases from these increases in fertilizer application. Although the increase would not be as large proportionately in the North Central states, they would contribute 39 per cent of the total increase in crop production under the double 1950 rate. The western states have apparently achieved more nearly optimum fertilizer use rates already and would not show large response to increased fertilizer use, except on irrigated land.

The "double" rate of fertilizer would actually represent an increase of 83 per cent in total fertilizer use over 1950, since all crops are not considered. The increase in crop production would be about 12 per cent over 1950 or about 50 per cent more than actually occurred in the period 1950 to 1955. (Table 1.) It is obvious that either the actual increase was due to other technologies than fertilizer, or that the estimated production for the "double" rate was too conservative. It is likely that both possibilities are true.

The "triple" fertilization rate would add 25 per cent to crop production over 1950. The "full" rate would increase total crop production by 60 per cent over 1950, equivalent to a 44 per cent increase in total net agricultural production.

It is somewhat foolhardy to conjecture what the increases in crop production with which we have dealt would mean to total output when incorporated into the agricultural production plant in the form of feed and pasture for livestock as well as food consumed directly. In the recent past, total agricultural production has increased 1.8 units with every unit increase in crop production. Of course there can be nothing automatic about this relationship in the face of changing prices, costs, and demands. However, on the basis of this ratio the increase in crop production under the "double" level of fertilizer would give rise to an increase of

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16 per cent in total agricultural production as compared to 1950, or about 50 per cent more than the actual increase to 1955. The comparable increase in total agricultural production for the "triple level" would be 28 per cent, or about equal to projected consumption for 1965. Finally, an increase in value of agricultural production of 75 per cent would be associated with the "full" level of fertilization, which exceeds the projected increase in consumption for 1975 by 50 per cent. These estimates assume no change in physical efficiency of crops or livestock, and no change in enterprise or factor combinations except for those associated with increased fertilizer use.

It is likely that current land development activity could give rise to an increase of 9.4 per cent of farm production in 1975 over 1950. Assuming that we wish to incur the cost, we could increase production by another 27 per cent through more extreme shifts in land use, or a total of about 36 per cent. However, the second adjustment is very unlikely to be economically desirable in this period. With a rate of fertilizer use which might be somewhat in excess of the "quadruple" level of 1950 for the selected crops, it might be possible to increase the production of farm products to a level of 40 per cent above 1950, which, when coupled with the projected likely increase in land, would give the 50 per cent increase. The marginal return to fertilizer would still be quite high at this level.

The average value of crop production in the United States in 1950 was about \$29 per acre. Thus the first increment of fertilizer to achieve the "double" rate would be equivalent to about 75 million average acres in its ability to increase crop production. The contribution of the second increment would equal that of 58 million acres. Thus the substitution rates of fertilizer for land would be about \$11 worth of fertilizer per acre, and \$14 per acre, respectively, for these increments. These data give some basis for comparing the annual cost of securing the productive services of "new" land, including development cost, with an alternative which involves the application of principally variable inputs.

The foregoing analysis of fertilizer use possibilities deals with only one of the many types of inputs which figure in scientific progress in agriculture. It is difficult to conjecture as to the extent to which the application of existing capital inputs and techniques will be increased in the future, or to which the productivities of labor and management in agriculture will be enhanced by further educational activity. Even more difficult is it to predict what new inputs or techniques will be discovered, or in what ways agriculture may be organized and managed for production.

However, resource adjustments in the market relative to land use do not occur rapidly enough to bring annual production in line with demand. In fact, attempts to control production by restricting acreage have not met with signal success either.

## Some General Implications of Technology to Land Use Adjustments

With the thought in mind that the large increases in agricultural output will come from technological advance, we shall examine some of the implications to land use in the United States.

Heavier applications of variable inputs to crops and output-increasing technological developments affecting crops will tend to concentrate in areas with soils of higher productive elasticities—whether due to higher rainfall, topography, or other natural factors. The Corn Belt, the South, as well as some smaller areas in the northeastern part of the country, and irrigated areas in the Great Plains and the West are the likely beneficiaries of these types of changes. Crops have greater differences in their response to variable inputs. Thus fertilizer magnifies the differences between crops in terms of cost per pound of feed; the competitive position of corn has been strengthened in comparison to small grains. Similarly the use of phosphate has made legumes more competitive in the South. New varieties of oats have enabled this crop to replace barley in some areas.

Increases in nonland inputs and new output increasing technologies will thus widen the productive margins between lands of low capacity and those of higher capacity. After the necessary supply-demand adjustments have occured, assuming that they are necessary because of increased supply, the competitive ability of some areas will be diminished. For example, drier areas of the West and less responsive humid areas, which now raise corn and other feed grains, will shift to hay and pasture.

In the low rainfull areas, the output increasing factors, such as fertilizer, do not provide a farmer with much opportunity to increase his production on his more productive soil in order to release his margin acres to more extensive use, because of the low marginal productivities of these inputs. An exception might be the case of improved crop varieties, although the differential effects are probably not large. Another possibility in these areas lies in better moisture conservation. Some experimental work indicates real possibilities.

Cost reducing technology, such as that involved in mechanization, affects the cost per acre on soils of high and low productivity alike, in a given area and for a given crop. This should tend to extend the intensive crop margin on soils of low productivity, unless increased supplies and diminished crop prices lessen the incentive. Where low productivity is due to exploitation of soil resources, mechanization would tend to increase the incentive toward further exploitation.

In the extensive low rainfall farming areas, particularly the wheat area, the improvement in machinery design and new types of machinery have probably reduced the cost of producing wheat more than grass. Machinery has affected hay production, but not the harvesting of grass di-

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Mechanization and conservation practices. In the higher rainfall areas, technology would operate in another context in providing incentives to adopt conservation measures. The cost of making terraces and other engineering devices has been cheapened, relatively, with improved machinery; with continuing subsidy payments this should encourage the adoption of conservation measures on erosive land. Forage harvesters, improved balers, and drying equipment have reduced labor requirements for harvesting hay, particularly legumes. These along with the increased use of phosphate fertilizer, have probably enhanced the ability of legumes to compete with grain—at least small grains—and would provide an incentive for soil conserving rotations.

It appears that the effects of soil deterioration have been hidden by technology. It is estimated that the loss of cropland through soil erosion is taking place at the rate of one-half million acres per year. <sup>10</sup> Deterioration is taking place on 250 million cropland acres, reducing it one capability class in 10 to 20 years.

Effect of farm organization structure on land use. The continued movement of labor resources out of agriculture, the increase in size of farm, and the substitution of land for working capital attendant with these changes should all work in the direction of more extensive farming. This will probably not result in decreased production per acre, contrary to some expectations, but it should rather reduce the rate of increase of output per acre over time. Another device growing out of general technological development is part-time farming. This arrangement should extensify crop and livestock production in certain areas of quite productive soil, as for example in Illinois, as these farmers attempt to minimize their labor input and get high returns per hour of labor.

Price supports have provided incentives toward some types of land use which otherwise would be in weak competitive positions. At the same time acreage controls have been unsuccessful in reducing the production of these crops sufficiently that surpluses can be avoided. Crops particularly in question are wheat, cotton, and rice. Some of the incentives and limitations to adjustments which would reduce acreage and production have been noted. The extent of future reduction in lands devoted to these crops will depend importantly on the future course which agricultural price policies take.

<sup>&</sup>lt;sup>10</sup> A Graphic Summary of Land Utilization—1954, U. S. Department of Commerce and U. S. Department of Agriculture, Special Report, Vol. III, Part 4, Chapter 1, 1954.

Livestock and Land use. The increased requirements which are projected for the future (1975) for livestock and poultry products—beef, broilers, eggs and pork, milk in that order—will increase the competitive position of the crop enterprises which are complementary to them. Soil resources are already quite committed to dairy production in the northern and northeastern dairy region, so shifts in land use are not so likely here. However, the competitive positions of the feed grains, particularly com for poultry, hogs, and beef cattle, and of legumes and grasses for pasture and hay for beef production will be enhanced in the Corn Belt, the West, and the South.

Future land use in general. In the long run (1975) it would appear that although production will be enhanced by technology, major shifts in land use are not likely to occur in the Corn Belt. Assuming no price supports or acreage controls, some shift to corn from small grains and soybeans will take place. The stocks of feed grains will be utilized by live stock although occasionally at lower than parity levels. In the South, land use is likely to shift to corn and other grains and forage crops from cotton, rice and tobacco.

Shifting Plains lands to grass. There has been much discussion of policy aimed at getting marginal wheat lands shifted into grass in the Plains areas. This interest occurs because of the stocks of surplus wheat which continue to exist, as well as the hypothesis that much land is actually marginal for wheat as far as the comparative returns from it when under grass as compared to wheat. The Great Plains program includes measures aimed at this sort of shift. However, it is unlikely that such a shift will occur without more vigorous effort than we have had to date. The shift from grass to wheat, such as occurred during World War II, is easily brought about, and requires small capital inputs, especially if the land is added to existing farms. However, the shift to grass is difficult, is subject to a great deal of uncertainty, and is quite costly. In the device of the Soil Bank there is the possibility of bringing about this sort of shift, provided that the subsidy payments are high enough. In 1958, 7.8 per cent of the cropland in the United States is involved in the Soil Bank. Three per cent of the wheat land or 128,309 acres were included.

Before substantial shifts in acreage will occur, more monetary incentives may be necessary. Other possibilities are a rejuvenation of land zoning or the federal purchase, seeding, and control of land which is considered best used for grass in the long run, and greater incentives for the out-movement of labor. It is likely that governmental activity will have to be more imaginative if substantial shifts from wheat to grass are to occur. If we find it acceptable to subsidize the plowing up of grass-

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land for wheat in emergencies, it would seem equally acceptable to subsidize the reverse in positive terms when needs for food have changed. Perhaps our attitude toward other marginal lands should also be more positive and vigorous.

In the absence of a forceful re-grassing program some land will shift to grass from wheat anyway if the wheat price were to decline to its feed price. Other land would shift to sorghum grain as has been the case recently. Probably the large part of present wheat acres will stay in wheat, contributing to the total feed supply.

# DISCUSSION: SCIENTIFIC PROGRESS IN AGRICULTURE, LAND REQUIREMENTS AND LAND USE ADJUSTMENTS

JOHN F. TIMMONS

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Two alternative approaches confront the discussant of a professional paper. The discussant can criticize the paper in terms of emphasizing its contributions, disagreeing with the logic and elaborating upon omissions. Or, finding himself in complete agreement or in complete disagreement with the paper, the discussant can start afresh on the topic using the opportunity to present a paper of his own choosing within the scope of the topic.

I find myself neither in complete agreement nor in complete disagreement with the stimulating paper presented by Ottoson and Epp. Consequently, I have elected to follow the former approach and will discuss briefly the strengths and weaknesses of the paper.

The purpose of the paper is to examine the impact of scientific progress upon the land factor. This purpose is oriented in the disturbances between factors, between products and between factors and products occasioned by technological developments in agriculture.

The paper is confined largely, although not exclusively, to those changes in agricultural technology which bring about increased output from a given land base and to probable consequences of such changes with attending adjustments.

Technological progress takes place, according to the authors, through the achievement of a more optimum level of application of a given variable input to fixed inputs and/or through the adoption of new inputs made possible by technological invention or discovery. Use of these new inputs, termed innovation, either yields a new output function for a given schedule of resource inputs or lowers cost functions for a given schedule of outputs.

Applying the Daly demand estimates, the authors estimate the aggre-

gate increase in farm products by 1975 at 52 per cent over 1950 (40 per cent over 1955). This increased demand comes from both per capita and population increases. Resultant increases in net consumption of farm products are estimated at \$41½ billion in 1975 (in 1950 dollars) contrasted with \$27½ billions in 1950.

In searching for the means whereby this increased demand may be satisfied, the authors rely upon the conventional supply expansions from extensive and intensive margins. A farm production increase of around 10 per cent would come from current land development activities. An additional production increase of 40 per cent comes from a "quadruple" of the 1950 level of fertilizer use with fertilizer still showing a high marginal return. Thus, the necessary farm production of 50 per cent to accommodate the similar increase in demand would be realized—one-fifth from land development and four-fifths from fertilizer application to selected crops.

Let us look into the involvement of this reasoning as developed in the paper. Initial incidence of cost decreasing per unit of output technology increases the marginal productivity of capital and encourages substitution of capital for labor. This change, in turn makes it possible for a given amount of labor to operate more land, a trend very much in evidence. With the supply of land for agricultural use relatively constant, the increased demand for land in order to enlarge units of production, would increase land values, another trend much in evidence. In the process of farm enlargement confronted with many institutional restraints of land ownership, the tendency may well be to transfer at least part of the marginal efficiencies of capital and even labor into increased land values. Considerable evidence exists that expected farm program benefits have become capitalized into land values. It seems probable that similar capitalizations may be experienced in technological benefits. At least, the old J. S. Mill hypothesis invites further study.

Another involvement introduced by the authors is that in assuming inelasticity of demand, technological changes bringing increased production will decrease gross income to farming, and changes which decrease costs without increasing production would increase net income. But the aggregate demand estimates accepted in the paper are in the elastic range and the supply changes are mostly in the increasing range—both by around 50 per cent. Consequently, it is difficut to conceive how technological changes, bringing increased production up to around 50 per cent, would result in decreased gross income. Probably the answer to the problem rests in a major way upon a better understanding of supply responses in farm production embracing technological improvements.

Another involvement of the analysis is the differential capacity of lands to absorb increased capital necessary for implementing technological de-

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nds developments. The authors conclude that lands of high productive elasticities such as the Corn Belt, the South, irrigated areas of the Great Plains and the West, plus smaller areas in the northeast, are the likely beneficiaries of output increasing technology. Output increasing technologies of nonland inputs will widen the productive margins between lands of low and high capacity as concluded by the authors. This may mean that some soils relatively low in productivity at present, but possessing high capacity with high elasticities of production, may increase appreciably in productivity and values. On the other hand, decreasing cost-per-unit-of-output technology with little change in total output would increase the net returns of present lands of high productivity. This increase in net returns would tend to become capitalized in higher land values. More needs to be known about the relative capacities of various grades of land.

Missing in the paper is an adequate consideration of disinvestment effects of technology upon land resources. The authors do conclude that technological progress appears to obscure disinvestments that are taking place. However, technology may encourage disinvestment as well as investment, particularly when planning horizons of the planning agent are in conflict with optimum planning periods. Of course, as long as production moves forward or backward along the same production function, investment can increase production in response to increased demand. But the problem arises when production shifts to a lower production function from which shifts to the original function cannot profitably be achieved. Although limited evidence points to the possibility of disinvestment effects of certain technological practices, more research is needed to test this hypothesis.

Although the authors recognize interrelationships between physical possibilities and economic feasibilities in the application of technology, the role of institutional changes required by technological developments is not developed in the paper. Institutions, meaning social controls (both informal and formal types) over individual decisions, constitute important means which either facilitate or abstract both innovations and adjustments necessary for the realization of benefits flowing from technological change. Important adjustments in land use remain beyond the reach of the individual resource planning agent. These adjustments demand group action in changing institutions from retarding to facilitating forces in implementing needed adjustments in land use. Here again, research is needed to appraise existing institutions and possible changes in light of achieving desired adjustments.

The paper constitutes a scholarly contribution to professional thinking by providing improved orientation of some of the more important, as well as some of the more difficult, problems challenging agricultural economists.

## WORLD AGRICULTURAL DEVELOPMENT

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# TECHNOLOGICAL DEVELOPMENTS IN WORLD AGRICULTURAL PRODUCTION

WILHELM ANDERSON
Foreign Agricultural Service, USDA

ARAPID increase in agricultural production through improved technology is one of the outstanding aspects of economic development in the past two decades. Results of the technological developments taking place in the agricultural sectors of such countries as Canada and the United States are clearly evident and generally well understood. Less known, but of considerable importance to us from the standpoint of formulating domestic and foreign policies, is the impact of technology on agriculture in the underdeveloped countries, particularly those countries where increases in agricultural production are most needed to keep pace with rapid increases in populations. This paper presents a brief review of technology in world agriculture and examines some of its more important aspects.

For purposes of this discussion I have separated world agriculture into two broad categories, principally on the basis of climatic conditions and economic characteristics: (1) the agriculture of the temperate zones in rather well-developed, economically advanced countries, where a considerable share of agriculture is commercial; and (2) the agriculture in the rest of the world—partly in tropical and in arid or semi-arid lands,

largely subsistence-type agriculture.

Countries in Category I produce about half of the world's total agricultural output but have only about 30 per cent of the world's population. Countries in Category II, largely dominated by habit and custom, produce the other half but have 70 per cent of the world's population. These disparities account for many of the international problems that today harass the relations between developed and underdeveloped countries. Agricultural production in the first category is up perhaps 30 per cent since prewar days. Production in Category II is up almost as much, but population has increased much more than in the first group. On a per capita basis, production of the first group is up 12 per cent, whereas per capita production of the second group is below the prewar level.

I propose to discuss technological developments in Category I through a description of the course of events in North America and in Western Europe, with a brief glance at the Soviet Union and the labor-

extensive agriculture of the southern hemisphere.

# Category I

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In the United States, agricultural production and productivity have increased by leaps and bounds since 1940. With much the same area in crops as in 1940, and with about 30 per cent fewer workers on farms, total farm output now stands some 35 per cent above the 1940 level. Output per man-hour was up almost 50 per cent by 1949, and 100 per cent by 1957.

Increases in labor productivity reflect largely the rapid spread of mechanization. Between 1940 and 1957 the number of tractors and other motor vehicles on farms more than doubled, while inventories of other farm machinery and equipment nearly trebled. The cultivating and harvesting of grains and soybeans have been almost completely mechanized. In California, aircraft are used to seed and fertilize most of the rice and to apply pesticides to the rice fields. Many dairy farms are equipped not only with milking machines but also with such recent innovations as pick-up balers, hay driers, field choppers, automatic feeders, buildings for lose housing, milking parlors, pipe-line milkers, and bulk milk tanks. Newly-developed equipment has made sprinkler irrigation more practical and stimulated its extension, especially in the subhumid East.

Other striking signs of the revolution in crop production techniques include, for example, the increased use of fertilizer ad improved seed varieties. In recent years farmers have applied three to three and one-half times as much commercial fertilizer (in terms of plant nutrient content) as in 1940. In 1954, they planted 70 per cent of the crop acreage with varities not even in existence on a commercial scale 20 years ago.

Breeding, feeding, and management of dairy cattle and poultry have also made marked progress. Particularly impressive has been the rapid rise of a highly specialized, organized, and efficient broiler industry that puts on the market a completely-eviscerated, ready-to-cook, meat-type bird at a price per pound below that of red meat. Many commercial broiler growers now get a pound of live bird per 2.3-2.5 pounds of feed, and in some recent experimental feeding trials this was reduced to 1.9 pounds of feed.

Along with the spread of modern farm practices has come the need for more land per farm to make heavy capital outlays pay. The average investment per farm worker, at constant prices, has increased 70 per cent since prewar; in 1956 it amounted to nearly \$16,000 for the country as a whole, and reached as much as \$50,000 or more on many commercial family farms. At the same time, the number of farms has decreased, while the total acreage per commercial farm increased from 220 acres in 1939 to 333 acres in 1954, or by 41 per cent. Family farms have not lost out in

this process. They continue to control about the same proportion of the total acreage in farms as in 1940 and to produce about two-thirds of the total agricultural output.

#### Canada

Recent changes in the structure and organization of Canadian agriculture are also reflected in fewer but larger farms, heavy investment in additional machines and larger inventories of livestock, and the application generally of better techniques to increase productivity per acre and per animal.

Since 1941 the area of land occupied in farms has increased slightly. The area under crops has increased more than 10 per cent. For Canada as a whole, between 1941 and 1955, the number of farms decreased 12 per cent, their size increased 15 per cent, the production per farm increased 44 per cent, and production per acre 25 per cent. During the same period the investment in machinery and equipment increased 362 per cent, the value of livestock inventories increased 49 per cent, and operating expenses went up 58 per cent, all at constant prices. Since 1946, labor requirements on Canadian farms have decreased 30 per cent.

The most outstanding feature of these technological developments has been farm mechanization and this has been most outstanding in the prairie region, but important also in Ontario. The prairie region accounts for about half of the Canadian farm cash income and Ontario for some 28 per cent. In the prairie region the average size of farm increased from 411 acres in 1931 to 498 acres in 1951, whereas in eastern Canada the corresponding figures were 129 acres and 132 acres. The increase in size of the farms in the prairie region was accomplished through consolidation and greatly encouraged after 1946 by large expenditures for farm mechanization.

The recent trend in mechanization is likely to continue and accelerate as the growing labor requirements of Canada's industrial development compete in the labor market and tend to pull labor off Canadian farms.

Fertilizer use in Canada largely has been limited to high per-acre value crops such as tobacco, potatoes, fruits, and vegetables.

# West Europe

West Europe's agriculture has shown great vigor in the years since World War II, resulting in substantial increases in total production as well as in productivity. The estimated production for the current crop year is 29 per cent above the prewar level. Compared with the low postwar level of production in 1947-48, the increase is even greater.

With a 20 per cent decrease in manpower on West European farms, the increase in production per man is impressive. Wheat yields are up 40 per

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cent, rye 35, barley 30, and oats 20 per cent over their prewar levels, and the milk yield per cow is up over 12 per cent. Total output per unit of total input has increased by about 2 per cent per year in the 1950's. Behind this are spectacular increases in the use of fertilizers and in mechanization, improvement in plant and livestock breeding, in control of pests and diseases, and in general farm management.

Western Europe has long counted among its countries some of the world's heaviest consumers of commercial fertilizers. Nevertheless, the consumption of chemical fertilizers in 1955-56 was some 90 per cent greater than in 1938. Increased fertilizer use no doubt has been the most important single factor in raising postwar crop yields.

Mechanization of European farming as expressed in tractor numbers is quite recent and spectacular: the number of tractors now is 10 times as great as in the mid-1930's, or 2,000,000 compared with 200,000.

In Mediterranean Europe irrigation also plays an important part in postwar agricultural plans. The much publicized Italian land-reform plans of 1950 and the more recent 10 year economic development plan (the "Vanoni" plan) have added impetus to existing programs for irrigation. In 1957 Spain reported that government programs had brought some 650,000 acres of land under irrigation since 1950. In Greece, the postwar reconstruction program was responsible for bringing irrigation to some 150,000 acres of land between 1948 and 1954.

European plant breeding work is of long standing. The development of new wheat varieties has been one of the more outstanding recent achievements in France and Italy, contributing much to increased crop output. But plant breeders in many countries have also done extensive work with potatoes, grasses, oilseeds, fruits, and vegetables. Hybrid corn has been introduced in many countries with marked increase in yields.

The last two decades have seen the rapid development of new chemical crop protection means in Europe. The discovery and widespread use of DDT, benzene hexachloride and selective weed killers may be mentioned.

The widespread use of artificial insemination of cattle in recent years has contributed much to the improvement of Europe's dairy breeds and raising of milk yields. Insemination of hogs is beginning. Progeny testing is being adopted or reorganized in several countries.

Much work has been done to develop local feed resources and to increase the nutritive content of feeds through better feed processing, feeding methods, and other aspects of livestock care that improve feed conversion. Since grasslands provide the greatest and least expensive part of the livestock feed, improved grassland management has loomed large in these efforts.

Special efforts have been directed towards the eradication of bovine tuberculosis, brucellosis, bovine mastitis, and foot-and-mouth disease. In-

tensive action programs have resulted in almost complete eradication of bovine tuberculosis in the Scandinavian countries and the Netherlands and greatly reduced occurrence in the United Kingdom, West Germany, and elsewhere. The fight on brucellosis shows a somewhat similar pattern. There was a serious outbreak of foot-and-mouth disease as late as 1951-52, but a combination of measures—vaccination, slaughter, and restriction of movements of animals—has prevented further serious outbreaks.

Technological progress has also been considerable in the communist countries of Eastern Europe, but lags far behind western Europe. Not only was the postwar start from a much lower level of technology, but the application of scientific achievement has been impeded by social and political changes depriving the farmer of incentives for production.

### Soviet Union

Mechanization of farm operations has been the outstanding technological development in Soviet agriculture during the past 30 years. It has accompanied forced agricultural collectivization (though with a time lag) and proved a potent instrument of state control and direction of collective farming.

The extent of mechanization, however, has been uneven for different crops and operations. While plowing of the land and seeding of grains, cotton, sugar beets, and harvesting of grains are thoroughly mechanized, mechanization is lagging in the harvesting of corn, cotton, and sugar beets, in the planting and harvesting of flax, hemp, potatoes, vegetables, having, and in most of the farmstead operations.

Despite much inefficiency in the use of tractors and other machinery, it was possible for the Soviet Union to expand its crop area from around 360 million acres in 1950 to over 480 million acres in 1956, largely by the use of tractors to break up new land in the semi-arid zone beyond the Volga and the Urals. At the same time a considerable reduction of manpower used in agriculture took place, though by western standards it is still exceedingly large. According to Soviet sources, the proportion of population engaged in agriculture and forestry decreased from 80 per cent in 1928 to 56 per cent in 1937 and to 43 per cent in 1955 and 1956.

Less progress was made in other phases of technology, and yields per acre continue to be low. Improvement of crop varieties through plant breeding was retarded by "Lysenkoism," whose grip on Soviet agricultural science has only recently been loosened. The output and use of commercial fertilizer, it is true, increased very rapidly and is now more than three times as large as before the war. But it still falls far short of requirements. While there are considerable potentialities for irrigation, so far it has been confined largely to the Soviet cotton belt in the dry regions

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Cana tralia cour of the culticapi of central Asia and Transcaucasia. There are ambitious plans to expand the irrigated acreage, but progress has been slow.

# The Labor-extensive Agriculture of Oceania

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Tremendous strides have been made in mechanization in Australia and New Zealand. Greater use of tractors, heavy-earth moving machinery, and electrically-powered equipment in rural areas has been noted in both countries since the late 1940's. Aircraft are being used for fertilizing, seeding, fencing, and spraying to develop hill pasture lands. Approximately 4 million acres of New Zealand's farm land was fertilized by air in 1957.

Superphosphates account for more than 80 per cent of all fertilizers used in New Zealand and over 95 per cent of those used in Australia. Since 1935 the use of superphosphates in Australia has doubled, and in New Zealand it has trebled. Large amounts of these phosphates have been applied to pastures, reflecting the decreased emphasis on grain crops in favor of livestock after World War II. Soil fertility has also been improved in both countries by greater use of trace elements such as molybdenum, copper, and zinc.

Progress has been made in recent years in crop and animal research in both countries. Particular emphasis has been placed on development of high quality grains and grasses to promote early maturity, drought and disease resistance. Attention has been given to sheep and cattle breeding to improve the quality of wool and meats. Dairy production has been increased to high levels in New Zealand by the wider employment of artificial insemination. The introduction of myxomatosis virus in Australia in 1950 for the eradication of rabbits has paid high dividends in the form of increased pasture and crop yields, greater sheep numbers, and larger wool output.

Commercial agriculture in the temperate zone of the southern hemisphere that is operated by labor-extensive methods includes also the agriculture of Argentina and Uruguay, as well as some of the agriculture of the Union of South Africa. In view of the limitations in space, I shall give only a few brief references to these areas in later sections of this paper.

Thus far we have covered briefly the more significant technological developments in the agricultural production of the United States and Canada, the countries of Western Europe, and the Soviet Union, Australia and New Zealand. We also touched upon the situation in the countries of Eastern Europe. These countries account for only 30 per cent of the world's population but contribute 50 per cent of the world's agricultural production, as indicated earlier. On a value basis, production per capita in the United States and Canada is twice that of what it is in

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Western Europe, the Soviet Union and in Eastern Europe. On a wheat equivalent basis, agricultural production in the crop year 1955-56 was 2,100 kilograms per capita in Canada, 1,820 in the United States, 910 in Western Europe, 875 in the Soviet Union and 810 in Eastern Europe.

# Category II

The countries in Category II include the underdeveloped areas of the world. These areas include all of Asia except Japan, which is highly industrialized, all of Africa except portions of the Union of South Africa, and all of Latin and South America except Argentina and Uruguay. Many of the underdeveloped countries of Asia and Africa have gained their independence and sovereignty in recent years. Some of them are having difficulty getting organized politically. Nearly all of them are having balance of payments difficulties.

Most of the underdeveloped countries are densely populated and less advanced agriculturally than the industrialized countries which were discussed under Category I. Even though the civilizations of Asia and parts of Africa are very old, the rural people generally are illiterate. The available arable land per farm family is generally exceedingly small—some five acres in India, four acres in Pakistan, two and one-half acres in Korea, two acres in Indonesia and Egypt—and generally ranging from two to ten acres per farm family.

Per capita income for most of the underdeveloped countries is very low ranging from \$50 to \$150, with per capita farm income even lower. In such a setting in which you have illiteracy, exhausted soils, extreme poverty, and limited land resources, you find as one of the outstanding characteristics the heavy influence of habit and custom on farm practices. Since crop failure means famine and outright starvation, farmers in these areas hesitate and are reluctant to make any change in production methods for fear it may result in lower yields and even in crop failure.

# Asia, Including Mainland China

Asia accounts for 55 per cent of the world's population but contributes only 34 per cent of the world's agricultural production.

Since the end of World War II agricultural production has increased substantially in Asia, and there is evidence of some technological advancement.

Fertilizer is not extensively used, although consumption has been increasing steadily in the past few years. However, Japan ranks with the highest consumers of fertilizer per arable acre anywhere in the world. By heavy fertilization and other good agronomic practices, Japan continues to increase the productivity of its scarce arable land and obtains yields for most crops several times those of most other Far East countries.

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Planners in Asia look upon the use of fertilizer as one of the prime vehicles to increase agricultural production. India's second 5-year plan targets an increase of 15.5 million tons in foodgrain production. Nearly 4 million tons of this increase is to be achieved by expanded use of fertilizer. Pakistan's 5-year plan also provides for increased production and use of fertilizer to increase agricultural production.

Much of the agricultural production in Far Eastern countries comes from irrigated land. Expansion of the area under irrigation and improvement of old irrigation systems are vital elements in agricultural planning throughout the area. Under the impetus of the first 5-year plan, India increased its irrigated area from 51 million acres to 68 million; the second 5-year plan calls for adding an additional 21 million acres. Pakistan's development plans also call for huge expenditures on irrigation and land reclamation schemes.

Similarly Burma, Thailand, Ceylon, and the Indochina countries are all developing further irrigation, water control, and land reclamation projects, but farm mechanization has made little progress in the Far East countries.

Governments also are carrying on plant breeding work to develop higher yielding varieties of crops. Getting the results out to the producer is a difficult problem. Part of the difficulty lies in maintaining the improved varieties because of the ignorance of the growers and the lack of storage facilities. Replanting of the rubber estates in Malaya and Ceylon, with high producing young stock furnished by the governments, is increasing rubber production and lowering production costs. More gradual progress is being made in improving yields on coconut and tea estates in the Far East.

Possibly more significant than the plant breeding work, from the standpoint of over-all crop production, are the improved cultural techniques that are being introduced. In a recent survey in Pakistan, it was found that the yield of seed cotton in line sown fields was a third higher than when sown broadcast. In India yields of rice grown by the Japanese method have been from 50 to 100 per cent higher than rice grown by local methods.

Aerial spraying and dusting have become prominent in West and South Asia in combatting locust infestations.

Plans and programs in Communist China for improving agriculture feature extensive collectivization, and the massive use of cheap human labor in such jobs as constructing small dams, digging ponds, irrigation ditches, and wells, and reclaiming small scattered plots of land. Such projects can show quick results, and are done largely by local resources. Under Communist policy, capital investment funds go mostly into industrial development.

An adequate supply of chemical fertilizers is an urgent need. An-

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nounced plans call for raising domestic production of fertilizers from 750,000 tons of fertilizer carriers in 1957 to 5-7 million tons by 1962 and up to 15 million tons by 1967. These goals may provide some indication of the need, but are believed to be far in excess of what the country can achieve.

Mechanized farming is receiving less official mention than was the case a few years back. Human and animal labor will provide the bulk of China's farm power for an indefinite future. Emphasis now is on providing improved water wheels, mechanical power for operating irrigation pumps, animal-drawn equipment, and hand tools.

Opportunities for land reclamation in China are small. Consequently, most of the increases in production will have to come about by raising yields per acre. Current efforts are directed at increasing yields by multiple cropping, close planting, use of improved seeds, measures to control insects and disease, and other modern cultural practices, of which water control and fertilizer supplies are the most critical elements.

In West Asia by far the greatest advance has been made in the expansion of cultivated areas through irrigation, drainage, and the use of tractors. Between 1950 and 1955 Iraq and Israel more than doubled their irrigated lands; Syria and Iran increased their irrigated acreage by 30 per cent, and Turkey by 35 per cent. Also, Turkey increased its total arable land by 48 per cent. Further expansion of cultivated land is likely to take place. Irrigation schemes, planned or under construction in Syria, Iraq and Iran, may double the irrigated areas within the next 15 years.

Farm mechanization has made significant beginnings in West Asia. Israel leads, on a small country scale, by virtue of its highly industrialized economy that is rooted in Western technology. Turkey leads in magnitude of change under a state-inspired and controlled scheme of mechanization. Syria's production of cotton and grain is the best illustration of mechanization through private enterprise. Little has as yet been achieved in West Asia to improve livestock or to breed and select better plant varieties.

# Africa

The pattern of agriculture in the northern segment of Africa is similar to that of West Asia. Ancient methods prevail, yet modern technology is becoming increasingly evident.

The case of Egypt, with 24 million people, is unique. Its population has been increasing at a rapid rate, whereas its crop area is limited to 6 million acres. All water available from the Nile is used for irrigation, and the land is cropped intensively. Mechanization is used to supplement intensive human labor for certain farm operations, such as land preparation.

Soil fertility and high yields are maintained through generous applications of fertilizers. Improved seed varieties have been developed and used successfully, and some improvements made in livestock. Effective control of plant and animal pests and diseases is maintained.

South of the tropical belt, the Union of South Africa has seen considerable progress in agricultural technology. Mechanization and use of commercial fertilizers have increased significantly. Irrigation covers close to 6 per cent of the total arable area. The Union's advances in pest and disease control and livestock and plant improvement have been significant.

In the tropical belt, technological developments have been limited mainly to the agriculture of European settlers or plantations and to certain export crops. The bulk of African farming is on subsistence levels, with primitive techniques prevailing. Africa accounts for 8.5 per cent of the world's population but contributes only 6.6 per cent of the world's agricultural production.

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The expansion of irrigation and mechanization are the outstanding technological developments in Latin America in recent years. Several Latin American countries have large irrigation schemes underway. Mexico, in particular, has a long list of completed projects. Chile, too, has a large percentage of its arable land under irrigation. In Peru, the coastal population is entirely dependent on irrigation for its livelihood.

The development of mechanized farming in Latin America has been significant since the war. In 1939, only 30 per cent of the total number of tractors was outside Argentina; in 1952 the percentage was 75. Argentina, Mexico, and Brazil have all increased substantially the use of tractors. In Uruguay 80 per cent of the cultivated land is farmed mechanically, in contrast with 20 per cent for the region as a whole.

Fertilizer consumption in Latin America is still low.

Over-all production of crops in Latin America has increased over the years faster than the area cultivated, indicating an increase in yields. Improved corn and wheat varieties have been developed in Mexico. Similar programs are underway in Columbia and Central America.

Significant advances have been made in animal breeding and feeding in Argentina and Uruguay, and Chile has a national program to improve its livestock industry. Mexico is encouraging increases in the numbers of livestock and betterment of the quality through the establishment of breeding stations.

Latin America accounts for only 6.8 per cent of the world's population but contributes 8.8 per cent of the world's agricultural production.

Of the underdeveloped areas of the world, the great food problem area

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of the future is Asia, and particularly the Far East, which holds 52 per cent of the world's population but accounts for only 32 per cent of the world's agricultural production. In India several successive years of favorable weather have brought into being large food supplies, and this coupled with successful medical care and sanitation programs have had the effect of cutting down the death rate to such proportions as to raise the net annual increase in population from 14 to 2 per cent. This increase means that India, with a present population of 400 million, will now have 8 million additional people to feed annually instead of 5 million. Improvements in transportation are now making it possible to move food about quickly to avert famine in dought and other catastrophic areas. Although these improvements in medical care and transportation are undoubtedly among the great blessings of mankind, they, nevertheless, bring with them certain effects upon population growth that merit serious study if the food needs created thereby are to be met. This is all the more so if the area most affected is already a food deficit area. On a wheat equivalent basis, for the crop year 1955-56, agricultural production in Asia was only about 425 kilograms per capita, less than one-fourth of what it was in the United States.

#### Conclusion

What conclusions for the world's food and fiber supply might be drawn from this cursory review of developments in agricultural technology around the world?

(1) The growth of agricultural productivity after World War II has been considerably greater than during any similar previous period. In some of the industrialized areas, the growth of labor productivity in agriculture has been greater than in industry.

(2) The growth of agricultural production as related to food and fiber requirements has been uneven throughout the major areas of the world. It has been highly favorable in North America and unfavorable in most of Asia.

(3) Asia is losing ground in its ability to feed itself and is becoming a major world food deficit area. This situation is likely to worsen very considerably over the next 25 years while the Far East populations are gaining literacy, developing extension services, and building the fertilizer plants necessary to increase yields significantly.

(4) Notwithstanding the difficulties that will beset the Far East in particular, it seems highly likely, in view of recent and prospective developments in agricultural and related technologies, that mankind will successfully devise means of feeding, clothing and housing itself as far into the future as can now be seen. This may involve some checks on population growth, some deviation from conventional methods of food

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production, and the movement, over the next generation, of increasingly large quantities of food and fiber from surplus to deficit areas under financial arrangements that in part may be net additions to resources of needy nations.

# DISCUSSION: TECHNOLOGICAL DEVELOPMENTS IN WORLD AGRICULTURAL PRODUCTION

#### HAROLD A. VOGEL

Food and Agriculture Organization of United Nations

Anderson has given us a very useful review of the comparative progress of the several regions of the world in the improvement of agricultural production since the last war. We would all agree that he accepted a very difficult assignment. Lacking comparable data and other basic information from most of the lesser developed regions, he has had to rely heavily upon the interpretation of intelligence reports and field observations for many of his conclusions on technical advancements which are taking place in these countries. We in Food and Agriculture Organization (FAO) depend upon similar kinds of information, much of which however arises from FAO sources, particularly the unpublished periodic progress reports of FAO country and regional missions and the programming and evaluation studies associated with our technical assistance program. For the most part there is a high degree of consistency between Anderson's conclusions and generalizations and those of the FAO missions, except that our staff reports tend to be somewhat more optimistic in assessing the progress being made in technological developments in most countries included in his Category II. This is especially true for Asia and the Far East.

Since Asia is a significant food supply problem area, I have made a special effort to try to identify what elements of progress are being emphasized by the FAO staff from this region which might explain their more optimistic conclusions. In doing so, I am not suggesting any criticism of Anderson's careful analysis, especially since most field experts naturally place special values upon their own fields of work. Such programming and progress reports are of interest, however, in helping reveal which lines of technical work are being emphasized most in the lesser developed areas as a possible indication of significant developments which may materialize a few years hence.

These reports indicate that most countries of Asia and the Far East have in the past two or three years been giving a great deal more attention to the systematic organization of field trials and experiments, demonstration and pilot projects, and other forms of applied research, than was

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the case in the earlier stages of the technical assistance program. It seems evident that there has been a marked change in the views held earlier by many governments that advanced technical knowledge, including improved varieties of seed and breeds of livestock, could be transferred from the more advanced regions and adopted within their own countries through some form of short-cut procedure. To be sure, these field trials and demonstrations at present apply to only a limited proportion of the agricultural area of these countries, but I am very much impressed with the growing number of requests received for this type of assistance and the frequency with which success is being reported.

Farm mechanization has made little progress in this region, which has about 100,000 agricultural tractors compared with nearly 2½ million in Europe. Interestingly, requests for technical aid have placed very little emphasis upon projects involving the utilization of power equipment, except in three countries where the central or provincial governments have established tractor pools.

Most encouraging is the emphasis being given to the improvement of small tools and equipment, particularly improved implements which are being produced locally. The frequency of reports that peasant farmers are acquiring more and more of such simple but improved implements appears to be a significant technological development which is likely to gain momentum in the years immediately ahead.

Another impressive development concerns the extent to which governments, merchants, and to a somewhat lesser extent, peasants, are taking measures to improve their grain storage facilities and to reduce the infestation losses of stored grain, particularly rice. Very little progress seems to have been made, however, in the reduction of field losses from insects and rodents, except in areas participating in the locust control program.

Some instances of notable progress are being reported in the field of animal husbandry. This is definitely reflected in the larger numbers and the better quality of work stock. Some progress is reported from the main rice-producing sections of the region in encouraging farmers to produce some supplementary feed for their work stock, normally dependent upon rice straw as a main source of feed for several months during the year.

Advancement in livestock breeding, particularly in the tropical and subtropical countries, seems to have been discouraged temporarily as a result of a series of unfavorable experiences in the early postwar years, resulting from the importation of exotic breeding stock from temperate zones. Frequent failures of animals which were not heat-tolerant to this new environment, have been a serious obstacle to livestock improvement efforts.

I appreciate that the information taken from field project reports may tend to overemphasize the extent to which technological progress is being

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made in Asia and the Far East. However, a number of technological developments of a rather elementary but fundamental nature are taking place in many localized areas scattered through the region, in association with community development efforts, fundamental education centers, agricultural extension projects, field trials and experiments, religious missions, and others. As a by-product of the strong national pride which exists in this region, we may expect governments and the local rural leaders to put forward extraordinary efforts toward the steady improvement of agriculture. For these and other reasons I am concerned with one of Anderson's conclusions, namely, that Asia is losing ground in its ability to feed itself and that this situation is likely to worsen very considerably over the next 25 years. While I agree with Anderson that Asia is the great food problem area of the world and that any significant improvements in the near future are dependent upon a great amount of direct and indirect external assistance, I cannot agree that the situation is likely to worsen considerably over the next 25 years.

Despite the rapidly growing population, Asia, during the past 10 years, has been able to raise its per capita food production from about 86 to 94 per cent of prewar levels. Perhaps I am being overly impressed by the programs of governments and the progress reports from various technical assistance missions, but I can see no basis for concluding that this upward trend, gradual as it may be at present, will not continue. In fact, there are a number of encouraging elements of a technological, institutional, and psychological nature in the agricultural picture of Asia today which will serve as motivating forces to help most of these nations achieve an accelerating rate of economic and social progress in the years immediately ahead. Many of these elements are difficult to evaluate and explain in terms of our traditional measures of technological progress. Nonetheless, it is significant that at least half of the governments of Asia have, in the past two years, taken some definite steps to assure that the agricultural sector of their economies will receive much greater attention in future development plans and programs. Similarly, it is significant that some encouraging progress has been made in breaking down some of the institutional obstacles to development.

It is encouraging to note that some of the governments at least, are taking a serious interest in national food management programs, including the effective utilization of surpluses, the creation of national and local food reserves, and various schemes for institutional feeding, and the provision of emergency food relief. These and other factors associated with the pride of nationalism will, in my opinion, help overcome the "survival complex" which has represented a significant obstacle to technological progress in agriculture.

# SURPLUS DISPOSAL AS A TOOL FOR WORLD DEVELOPMENT -OBJECTIVES AND ACCOMPLISHMENTS

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JOHN H. DAVIS
Harvard School of Business

URING the past four years the United States has carried forward the largest foreign surplus disposal operation ever undertaken by any country—largely under the authority of Public Law 480.

For the benefit of any who do not recognize the term Public Law 480, its longer name is the Agricultural Trade Development and Assistance act, passed by Congress in 1954, authorizing the sale of United States farm surpluses for local currencies in countries that have need for such commodities but lack dollars with which to pay for them. Under Title I of this act the United States has disposed of about \$4 billion worth of products during the past four years.

The objective most emphasized by the proponents of Public Law 480 in 1954 was the disposal of United States farm surpluses, which at the time were accumulating in the hands of Commodity Credit Corporation (CCC) at the rate of almost \$3 billion per year. Also stressed as objectives of the act were assistance to economic development in receiving countries and the stimulation of permanent export markets for farm products. Let us now look at the accomplishments.

# Surplus Disposal

The surplus disposal phase of Public Law 480 when measured in terms of quantity moved has been successful, even beyond the expectation of its enthusiastic proponents. Whereas the original authorization permitted sales aggregating \$700 million during a three-year period, the actual sales during that interval were slightly in excess of \$3 billion—the additional quantities having some authorized through subsequent amendments to the act. (Throughout this paper, dollar references to surplus disposal will be in terms of the cost to the CCC unless otherwise designated.)

However, when weighed in terms of longer time implications to United States agriculture, its effects are harder to assess. Certainly Public Law 480 has reduced the storage problem for the CCC. Also, it has reduced the pressure of surplus stocks on commodity markets.

On the other hand, there is the question, what has it done to the implementing of basic adjustments that need to take place in order to adapt United States agriculture to the new technology that is evolving at almost explosion tempo? Has Public Law 480, by reducing the pressure from surplus stocks, retarded the rate of adjustment? Has it altered the course of other phases of farm legislation?

These questions are difficult to answer. If one considers such gauges as changes in the number of farms, the number of farm workers, investment per farm or output per farm worker per hour, it is difficult to make a clear case that adjustments have been retarded. Even if some slowup has taken place, it might be argued that the rate of change still is fast enough.

However, even if one assumes that to date Public Law 480 has not seriously hindered or skewed adjustments in the food-fiber sector of the economy, there is the possibility that it might in the future, if the program were to continue five years or longer, which seems likely. Therefore, it is only prudent that this aspect of the Public Law 480 programs be given serious study by economists and others.

## Assisting Economic Development

The proponents of Public Law 480 argued, in 1954, that it could make a contribution to economic development in low-income countries. This contention was based on the premise that the consumption of additional commodities in such countries could (1) add to labor productivity and (2) improve the climate for foreign credit and investment and (3) that the local currencies generated by the sale of such products could be employed to increase the rate of economic development.

There is no doubt as to the validity of the first two of these contentions. Public Law 480 has made possible a per capita increase in commodity consumption in a number of countries and, as will be explained later, has contributed towards a better climate for outside credit and investment. The benefits along these lines have been substantial and significant.

Use of Local Currencies. The contribution to date towards economic development resulting from the use of local currencies generated by Public Law 480 sales has been quite limited. About 30 per cent of these currencies have been reserved for United States expenditures not directly associated with country development. Of the remainder, not much more than one-fifth has been put to use—the balance remaining on deposit to United States account. While this delay has been occasioned by a complex of factors which vary country by country, an important one has been that the countries, in general, have not felt an urgent need for the funds. This, in part, reflects the fact that the United States has attached various conditions of control and payment. For example, the United States has generally sought a "maintenance of value" provision to hedge against currency depreciation, a policy the validity of which needs critical evaluation. Therefore, governments have felt that they could obtain local currencies more advantageously through other means, including that of direct issuance.

Further contributing to delay in the use of funds has been a fiscal con-

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sideration—that because in most countries the commodities were consumed promptly, while the local currencies remained idle on deposit, the subsequent release of such currencies would tend to add to inflationary pressures. Of course, the degree to which this is damaging depends upon the general fiscal policies pursued by the country at the time and the size of the funds involved relative to the total investment expenditures of the country.

Even aside from these considerations, it can be argued that the local currency of a low-income country held by a foreign government has but limited direct value as an agent for accelerating the rate of economic development. In general, such currency has a very low convertibility, which is to say that its use is more or less restricted to the procurement of domestic resources and domestic labor. Because the government of a recipient country has the power to create its own currency at will, it can even be argued with considerable merit that the release of local funds held by the United States within such country has little or no positive effect on the rate of employment or the rate of economic development. Moreover, should the existence of such United States holdings cause a reduction in the volume of United States dollar aid to such countries, or should the release of currency add to inflationary pressures, the rate of economic development might even be retarded.

Indirect Benefits. Public Law 480 assistance provides certain indirect benefits to economic development which are of considerable importance. It bolsters the outside credit and investment potential of a participating country—particularly in terms of productivity and the rate of economic growth. Public Law 480 also provides a mechanism for amassing funds that are supplemental to the regular budget of a country. In certain low-income countries this is important because of the low yield from imposed taxes. For example, in one country over 50 per cent of the "economic development fund" comes via Public Law 480. In others local currencies are used to assist selected economic sectors such as agriculture.

Another possible use is the creation of a special loan fund to assist the private sectors of the local economies—particularly enterprises which will generate increased foreign exchange earnings. To date, the so-called Cooley amendment, which authorizes the setting aside of up to 25 per cent of all Public Law 480 receipts for loans to private firms, has not met this need, largely because of resentment to alleged preference given United States firms. In general, this is true even though ways can be found under Section 104 of Public Law 480 for making comparable loans to domestic firms. For example, the local government could use a portion of the proceeds allocated to it as a loan fund to domestic firms.

Another problem relating to local currencies is the disposition of funds accruing to the United States from the repayment of loans. Since loans

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are made for as long as 40 years, this problem will continue over a long period. Public Law 480 itself is silent on the subject of repaid funds as are the country agreements negotiated to date. Except for a few countries which have received relatively little assistance, the United States cannot during the next decade or two, at least, demand the conversion of repaid proceeds to dollars without checking the development of the country involved.

Aside from conversion of repaid loan proceeds to dollars—which is hardly a choice—the alternatives are to reloan the local funds, to grant them to the country government, to grant them to institutions engaged in education, health services or welfare, or some combination of such uses.

With respect to efforts to support education, health, and welfare, emphasis should be placed on assisting those functions that are lagging seriously behind the needs of the country. Such assistance should be directed to getting such functions started, with assurance that other sources of support will become available within a reasonable time.

One means of channeling funds to such uses in an orderly manner might be through a joint United States-local country nonprofit foundation governed by a board composed equally of outstanding persons from each country.

Rather broad latitude as to the uses and re-uses of funds will be necessary if the widely varying needs of cooperating countries are to be met. The relationship of the United States with recipient countries no doubt could be strengthened materially if the United States promptly were to clarify its policy regarding accumulated funds, country by country, and then in the future, negotiate terms of currency use and re-use at the time the commodity terms are agreed upon.

Tri-Country Arrangements Are Difficult. One other means by which commodity assistance could be substituted for dollar aid is by negotiating triangular arrangements under which the Public Law 480 beneficiary (Country A) agrees, in lieu of paying the United States in local currency, to supply an item of its own to a third party (Country B) which otherwise the United States would have supplied at a dollar cost. The limiting factor is that situations of this kind are difficult to arrange. In general, any item which Country A would provide Country B at a dollar saving to the United States could have been sold by Country A into a hard currency market, thus earning foreign exchange. In view of the tight foreign reserve status of most Public Law 480 recipients, opportunities for triangular arrangements are rare. If, by hard negotiating, the United States were to force such transactions, the loss in good will likely would more than offset any dollar savings. Thus, on balance, triangular arrangements do not offer great promise as a device for reducing the need for dollar aid.

## Market Development

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As mentioned earlier, one of the much stressed arguments for the passage of Public Law 480 in 1954 was that it would be a vehicle for expanding commercial markets for United States farm commodities. Consistent with this contention, the act authorized the use of a portion of the local currency receipts for market development. Also, at the time of the transfer of the agricultural attache service from the Department of State to the Department of Agriculture, the latter stressed the importance of this move in terms of market development.

Of course, the limiting factor in developing commercial markets for United States products in low-income countries is the ability of such countries to earn dollars. In this respect the economic development aspects of Public Law 480 already discussed should have some long-run significance. Also, it is argued by some farm representatives, and no doubt with some merit, that the more aggressive market expansion effort made possible under Public Law 480 helps to offset the inherent weakness of agriculture in competing with nonfarm products for scarce dollars that have gone abroad.

In the short run, at least, a valuable by-product of the market development aspect of Public Law 480 has been the incentive and opportunity it has provided the representatives of numerous commodity groups to travel abroad. This can provide an understanding on their part which no amount of reading or study could give. Conversely, the market development knowhow of these persons and the exchange of ideas occasioned by their presence in a country can be of value to the staff of United States embassies, to foreign governments, and to the trade.

# Substitutable for Special but not Regular Dollar Aid

Generally speaking, Public Law 480 assistance is substitutable for dollar aid only to the extent that such aid is used by the recipient country to facilitate imports of food or fiber.

Since 1954, when Public Law 480 was enacted, most United States dollar aid has gone for help in economic development or for defense support. Because the basic purpose of this aid has been to provide dollars for the importation of essential materials—mostly from hard currency areasit has not been available for the purchase of food or fiber. Therefore, Public Law 480 has not been directly competitive with or substitutable for regular dollar aid to foreign countries.

Prior to the enactment of Public Law 480 the United States met critical food-fiber shortages in other countries through supplemental foreign aid legislation, commonly referred to as "famine relief." Since 1954 such needs have been met through Public Law 480 assistance—either by sales for local currencies under Title I or grants under Title II of the act.

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Considering the adverse weather, disappointing gains in agricultural production, and the per capita rise in food consumption in certain developing countries since 1954, it seems certain that the United States would have been called on to provide substantial supplemental food-fiber assistance during the past four years, even in the absence of any Public Law 480 program. Such assistance likely would have been in excess of \$2 billion during this period.

By meeting the critical food-fiber needs of other countries through Public Law 480 the United States has substituted such assistance largely for special foreign aid of the famine relief type rather than for regular foreign aid.

Avoiding New Competition

In carrying out the economic development phases of Public Law 480 the United States has sought to avoid stimulating new agricultural production which might compete with United States farmers for world markets.

When viewed in terms of short-run interests such a policy may seem to have considerable validity. However, when considered in terms of the longer run interests of the United States and other exporting countries, such policy doubtless would do more to limit markets than to expand them.

In this connection, exporting countries should recognize that their strongest foreign demand is from those countries that have developed their own resources most efficiently. Even though at times this may mean increased competition for certain products, it also means bigger markets for other products and larger aggregate markets.

Hence, it is in the interest of the United States and other exporting countries that economic assistance of all types be directed towards the efficient development of the resources of recipient countries.

# Phasing Out of Program

A serious aspect of Public Law 480 is the possibility that countries could become so dependent on the United States for food that the ultimate termination of the program will lead to serious food shortages and hunger in certain countries. This could be the result if Public Law 480 assistance were permitted to retard production by depressing prices to domestic producers, stimulate the net rate of population increase, or defer development of the type of supporting and export enterprises that would enhance the food supply of a country—either through expanded domestic production or through increased ability to import.

The only way to safeguard against this danger, assuming Public Law 480 assistance continues, is for both the United States and the recipient countries to anticipate and plan for the day when such assistance will ter-

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minate. Reasonable prudence would seem to dictate that all parties should be preparing for an eventual phase out of Public Law 480 programs, possibly beginning as early as 1962. In doing this, in view of the serious consequences of a food shortage, it will be far better to err on the side of countries having enough food available than to run a risk of having too little.

In this respect heavy moral responsibility rests on the United States to encourage recipient countries to seriously anticipate an eventual phase without United States food assistance. Even if one assumes a continuation of Public Law 480 operations at near the present level until 1962, decisions will have to be made this year by recipients, in order for them to increase their own food-fiber supply by that date—either by increased production or commercial imports. In urging safeguards against a food shortage occasioned by a reduction of United States surpluses, I am not predicting a shortage by any given date. Nor am I suggesting that Public Law 480 be terminated while surplus stocks exist. However, agricultural history reveals that under extraordinary conditions surpluses can disappear quite rapidly—even in a few months. It is against such eventuality that I am urging caution.

## Other Exporting Countries

Public Law 480 operations have engendered the accusation from other major exporting countries that United States surplus disposal is cutting into their established commercial markets.

An examination of the over-all international commercial movement of such items as wheat and flour, cotton, rice, and tobacco during the four years Public Law 480 has been in effect does not demonstrate this. The commercial movement during this period has generally continued consistent with past trends. This, of course, does not mean that certain countries cannot cite specific instances of interference. On the contrary, they can and have.

The strongest complaints have come from Canada—particularly over United States barter activities, which since May, 1957, have been restricted to cases where the United States has assurance that bartered farm commodities are additional to normal commercial imports. The case against the United States with respect to barter prior to May, 1957, was substantial, not only to the effect that there was interference wih Canadian commercial sales, but that the United States was interfering with its own dollar sales as well.

On the whole the United States has done but a fair job of maintaining satisfactory relations with other exporting countries on Public Law 480 matters. At times, particularly early in the program, it failed adequately to explain the reason for action, or did so with poor timing. Also, to a considerable extent United States' contacts with other countries have related

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to points of grievance rather than consultation over the program as a whole for the purpose of eliminating weaknesses and shortcomings.

One opportunity that the United States has not utilized to full advantage is that of discussing Public Law 480 problems multilaterally through the media of the Committee on Commodity Problems (CCP) of the Food and Agriculture Organization. Several years ago the Food and Agriculture Organization extended a friendly hand in this direction by creating a special CCP subcommittee in Washington for this purpose. Until recently the United States has shown considerable hesitance in discussing major problems and policies with this group.

On balance, the objections to Public Law 480 by other exporting countries do not appear to warrant the discontinuance or even general curtailment of Public Law 480 operations. As the program has progressed, intercountry understanding has improved. If the United States continues to improve its consultation with other friendly countries, I believe we will find that what now appear to be formidable problems will turn out to be more in the category of "molehills" than "mountains."

It is even possible that more adequate consultation with friendly countries might lead ultimately to some sort of a multilateral approach to certain types of commodity problems, with the result that something better than Public Law 480 would evolve. A starting point for exploring this might be informal discussions between Canada and the United States with respect to wheat. If this succeeded, other countries and international agencies could be brought into the discussions. Wheat has an advantage over many other commodities in that the bulk of the world's surplus is produced by countries well advanced in economic development. Furthermore, it supplies one of man's most basic needs—bread.

# Foreign Policy Considerations

Since the initial build-up of surplus farm stocks in the United States during the postwar period the question has persisted, isn't there some way these surpluses can be used to strengthen the peace and security of the free world? While this issue has been much debated, still surplus utilization plays only a limited role as a tool for implementing foreign policy. Evidence that this is true is found in points already discussed, such as the inadequate consultation with other exporting countries, the accumulation of unused local currencies, and the limited attention to the danger of overdependence of low-income countries on the United States as a source of food.

Without doubt a major factor discouraging a more comprehensive evaluation of surplus stocks as a tool for improving international relations has been the unrealistic hope that United States surpluses would be of short duration—a matter of another year or two. Only recently has there been a

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realization that sizable surpluses almost certainly will be with us for at least five years—probably averaging between \$1% and \$2 billion per year.

In recent months this realization is bringing about in the United States a more serious study of potential farm surpluses as a positive force in foreign policy. This, of course, is an endeavor which also might prove profitable for other countries—both those burdened with surpluses and those in need of food and fiber. Better still, as earlier suggested, countries might find it advantageous to supplement their separate studies on the basis of collaboration—not on grievances over present programs but on how surpluses might be used as a positive force in international relations.

## Major Issues

In recasting policies relating to agricultural surpluses a number of issues need to be considered, both separately and together. Important among these are the following:

- 1. How can we develop and sustain Public Law 480 operations that are in harmony with and in support of general foreign policy objectives?
- 2. What should be the relation between Public Law 480 and foreign aid?
- 3. How should we plan for the ultimate phasing out of Public Law 480 operations in countries receiving assistance in a manner to avoid hunger and suffering?
- 4. How can we maintain the desired rate of adjustment to technology within the food-fiber sector of the United States economy while we are operating a sizable Public Law 480 program?
- 5. How can we best utilize the local currencies accruing to the United States from the sale of surpluses—both initially and as loaned funds are repaid? Should we insist on a maintenance of value clause?
- 6. How can we improve and maintain the good will and cooperation of other countries—particularly exporting countries—in connection with Public Law 480 operations?

These are subjects which should receive the serious attention and interest of agricultural economists, working closely with persons from other related disciplines and with those administering programs.

# Perspective in Planning

Both in the formulation of general Public Law 480 policies and in overall planning with recipient countries it is essential to look ahead over a period of at least three to five years and sometimes longer in order to relate immediate decisions to future needs. Nowhere is this more important than in preparing for the ultimate phasing out of the program at the country

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level and in relating surplus disposal to adjustments in the rural economy at the home front. Failure to look ahead several years in policy making probably has been the greatest single weakness in Public Law 480 programming during the past four years. The kind of general policy formulation and country agreements referred to do not necessitate an actual extension of Public Law 480 authority for 3 to 5 years. The programming of commodity mixes, quantities, qualities, and schedules of delivery to recipient countries has to take place year by year, with provision for adjustments on a shorter time basis in order to meet season-by-season variations.

Even so, it would help give direction and purpose to Public Law 480 operations if the United States were to declare its long-time policy objectives and intentions with respect to surplus disposition, after due consultation with other countries, both recipients and exporters. This initial declaration could be made by the White House in the form of a statement or by Congress in the form of an act, or both.

A precedent for what I am describing exists in the case of the Marshall Plan. In that instance, four-year objectives and guidelines were declared, but authorization and appropriations were acted on year by year.

Role of Receiving Country. Assuming that the United States does do a good job of planning and executing Public Law 480 operations in the future, the ultimate value to a recipient country will still depend in large measure upon the development program of that country and on how well Public Law 480 assistance is geared in with it.

Economic development in low-income countries is an intricate and complicated undertaking—much more so than most economists have realized. It moves forward on a broad front affecting most every phase of human endeavor. Or more accurately stated, man has to modify most every aspect of his life in order to accomodate economic development—the size and number of farms has to change; the role of the village becomes altered; educational needs shift, both in terms of the kind of training and the number of persons who are to receive it; government has to provide new services; transportation and communication have to be developed; etc. Moreover, economic development programs have to be custom made, country by country, in order to take account of size, climate and natural resources and in order to be compatible with the culture and traditions of the people.

In large measure the people of a country themselves have to assume responsibility for economic development. Consistent with this policy the United States should seek to negotiate Public Law 480 agreements that are mutually satisfactory, including terms for the use and reuse of local funds along with commodity provisions, and which vest major responsibility for performance with the government of the country. Delay in so vesting authority over the use of local currencies has been a major factor in retarding the use of local funds to date.

#### Conclusions

Farm surpluses seem almost certain to continue in the United States for another five to 10 years. Also, it seems probable that a Public Law 480 type program will continue for several years.

Public Law 480 has proven to be a valuable experiment. Its success to date, despite lack of precedent, piecemeal planning, opposition in certain quarters, and the numerous other limitations discussed in this paper, would seem to have justified the undertaking.

Its potential as a tool for implementing foreign policy objectives exceeds that foreseen in 1954 when the act was passed as well as that realized to date. Also the experience of the past four years testifies as to the challenge that exists for the future; to utilize surplus farm products as a positive force for promoting international peace and security. In any given country, its contributions in large measure will depend upon the quality of the development program within the country and the ability of the United States and the local government to effectively relate Public Law 480 assistance to country needs.

# DISCUSSION: SURPLUS DISPOSAL AS A TOOL FOR WORLD DEVELOPMENT—OBJECTIVES AND ACCOMPLISHMENTS

## Frank Shefrin Canada Department of Agriculture

The main conclusion drawn from Davis' paper is that the program operating under Public Law 480 has been successful in moving surpluses out of the U.S. and increasing consumption in some of the underdeveloped countries. In respect to the other or secondary purposes of Public Law 480, that is, assisting economic development in receiving countries, reducing the need for U.S. dollar aid, and the stimulation of U.S. export markets, it has been less than successful.

The paper is confined mainly to a search for procedures that would allow for a more effective use of local currencies earned under Public Law 480 sales to facilitate more rapid economic development in the recipient countries.

We have to be realistic when taking a hard look at Public Law 480 and related U.S. surplus disposal programs. First, there is a tremendous surplus; second, it has to be moved and the U.S. government intends to move it; third, there are many hungry people; fourth, many of the economically underdeveloped countries are ready to take U.S. farm products under concessional terms; fifth, although the use of surpluses may not be the most efficient way of financing economic development, the scale of assistance would otherwise likely have been considerably less than what it has

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been; and sixth, the disposal of surplus farm products to needy countries on special terms is a generous and costly gesture, and it is doubtful if a similar program can be found in history. From a welfare and humanitarian point of view none of us can object to this type of program. Indeed within the limits of its capabilities, Canada has also extended aid of this kind.

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I cannot go along with Davis when he advances the argument that U.S. disposal activities have not resulted in a contraction of markets for other exporters and that even in many instances, in spite of U.S. activities, export markets have expanded. Other exporters could argue that they have received a smaller share of the larger market because of U.S. subsidized exports and that availability of these supplies has had an unsettling effect on world markets. Furthermore, other exporters cannot afford to compete with the U.S. when it comes to subsidized exports. It would be an obvious misuse of resources.

In addition, the new bumper crop of wheat does not indicate a reduction of Public Law 480 activities within the next few years. Thus the longer the program, the more difficult it becomes to avoid interference with commercial sales. After substantial volumes of a commodity have been moved on a subsidized basis for several years, it becomes almost impossible to determine what would move on a normal commercial basis if there were no special export programs.

As we all know, economic development, especially the type of "social-overhead" investment which is not expected to be self-liquidating (roads, reforestation), can be stimulated by the addition of extra food and other farm products to a country's resources. There are, however, limitations to the use of surpluses (via local currencies) for economic development. Hard currencies are required by underdeveloped countries for buying capital goods. Local currencies obtained by the sale of farm products under Public Law 480, when loaned back or used by the U.S. government, can be used only to pay for local products and labor.

Davis recognizes this, of course, when he says that local currencies generated by Public Law 480 sales cannot take the place of dollar aid needed to promote economic development from the procurement of imported industrial items.

There are several other shortcomings to the "surplus disposal" tool for economic development. These have been mentioned elsewhere, but they merit repetition. The first Davis recognizes when he stressed the fact that an ominous aspect of Public Law 480 is the possibility that countries will have become so dependent on the United States for food that the ultimate termination of the program will lead to serious food shortages and hunger in certain countries. His solution calls for "phasing" of the program, i.e. indicating the period of duration. This may have merit to both the recipient countries and other exporters, but it is not a solution in itself.

Longer run shortcomings were pointed out some time ago by W. H. Nicholls. These may, he said,

"be the prevention of much-needed expansion in that country's agricultural output (e.g. of fats and oils in Spain); the disruption of normal and economical trading patterns based upon geographical contiguity (e.g. Brazilian wheat imports from Argentina); and the strengthening of restrictionist forces in the United States when our subsidized agricultural exports return as manufactured goods (e.g. as Japanese textiles) to undercut our domestic industry. Thus, in the long run, such bilateral agreements as Public Law 480 envisages are likely to harm the recipient country, our allies of the free world, and even our selves, while seriously interfering with achievement of a more nearly optimum allocation of world resources."

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Another weakness is that contributions do not necessarily bear any relationship to the development needs of underdeveloped countries. The nature of the contributions might be determined by the pressure to "unload" commodities which happen to be in surplus at the time. This would tend to perpetuate chronic maladjustment of production in the donor country or countries, and also make development programming very difficult in the recipient countries. Programs would have to be adjusted to fit in with the quantities and types of commodities available which would likely vary from year to year. Furthermore, if surpluses come to be considered an appropriate form of aid, there may be a disinclination to contribute other more versatile forms of aid such as convertible currencies.

Davis does propose ways of making effective use of local currencies and indicates the responsibilities of the recipient countries. He also proposes that the U.S. pay more attention to other exporters, consult with other export countries so they would have a better understanding of what the U.S. is trying to do.

Davis dealt ably with a difficult subject. We are faced with two broad questions: (a) how can we attain an equilibrium of supply and demand in the commercial market; (b) if the equilibrium is only possible through a combination of commercial and noncommercial markets on the demand side, then the question is how can we most effectively change a noncommercial outlet into a commercial outlet without harming innocent participants.

With adequate safeguards it should be possible to direct the use of surpluses in areas of economic development that will not interfere with normal international trade and not be at the expense of other exporters. It is conceivable that some scheme of joint action could be worked out with countries conforming more closely to the rules of the game than is now being done within the framework of the Food and Agriculture Organization principles of surplus disposal.

# TROPICAL AGRICULTURE—COMPETITIVE OR COMPLEMENTARY?

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QUENTIN M. WEST Foreign Agricultural Service, USDA

The drive for political independence and a better economic life by the people living in the world's tropics appears destined to be one of the great developments of our time. Too little is known about the agriculture of this area and the relationship it has with agricultural production and trade of the United States. Many of these countries are now facing a critical period in their political and economic development, and it is appropriate that the program committee has singled out this area for special attention under the section on World Agricultural Development.

I recognize that I am addressing Canadian as well as American agricultural economists and that competitive and complementary aspects of tropical agriculture are of interest to both. Most of the discussion and the conclusions of this paper apply, generally, to Canada as well as the United States; however, illustrative data used refer only to the United States.

I shall begin by defining tropical agriculture for the purposes of this paper. I have included the agricultural production and trade of all the countries which lie principally between the Tropic of Cancer and the Tropic of Capricorn. Mexico, India and Formosa are included, Australia is excluded. East Pakistan is included, but West Pakistan is excluded.

In order to give a proper perspective to the discussion of this topic, I shall first describe briefly the agriculture of the tropical area and indicate its relative importance in the world agricultural economy. I shall then highlight the progress of economic development and the effect of increased agricultural production in the tropical countries on U. S. farm exports.

With this background we will be in a position to discuss the competitive and complementary aspects of agricultural trade of the tropical region and to give some details regarding our major agricultural exports and imports. The importance of the area as a market for U. S. exports and of the United States as the major market for many tropical products will also be pointed out. Finally, I shall touch upon the problem of Soviet economic penetration in the area through agricultural trade.

### Tropical Agriculture

This area is rather heterogeneous. The temperature is generally warm to hot but there are highlands with a temperate climate and even areas where it is too cold throughout the year for crop production. Rainfall varies from more than 80 inches in the rainforests of South America,

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Africa, and Southeast Asia to almost zero on the coast of Peru and some areas in Africa and Asia Minor. There are some soils which are fertile but many tropical soils are highly leached and are relatively unproductive. The economy of the region is basically agricultural with over 60 per cent of the population engaged in this occupation; however, types of agricultural organization range through nomadic herding, shifting cultivation, intensive subsistence cropping and highly developed plantations. Southeast Asia, including India, has been densely populated for centuries and includes some areas with more than 250 persons per square mile. Most of the rest of the tropical region is rather sparsely populated.

For centuries many of these countries have been colonies of other nations without free determination of their political and economic life. A large part of the people have been living at a subsistence level and the death of thousands in times of plagues and famine has been an accepted part of their existence. In most of the region agricultural techniques have remained practically unchanged for more than 2,000 years. Grain is still harvested by the sickle and is threshed under the hoofs of animals as it was in Biblical times. Most of the land is still plowed by oxen and the wooden plow, and in some areas the soil is only scratched with a stick by hand before sowing.

For the United States, Canada, and most European countries, the agricultural revolution began before the middle of the 19th century and has continued to gain momentum, especially following World Wars I and II. Some of the new techniques of the developed areas have been carried to the tropical world but principally on large plantations operated by Europeans or other large land holders. The agricultural revolution for most of this area is just now beginning.

### Importance in the World Agricultural Economy

This vast tropical area comprises an important part of the world. Approximately 36 per cent of the world's population and 37 per cent of the total land area lie within this zone. Even though its agriculture is largely underdeveloped and much of it on a subsistence basis, the region is of great significance to world agricultural production and trade. More than 25 per cent of the total world agricultural production comes from this area.¹ Almost 100 per cent of the world production and trade of coffee, cacao, rubber, jute, bananas, copra and coconut oil, and palm oil is from here. Also produced are three-fourths of the tea, over half of the rice, and almost half of the sugar of the world. Some crops which are commonly

<sup>&</sup>lt;sup>1</sup> Production is expressed as an aggregate in which commodities are weighted by price relatives based on the value of a metric ton of wheat. Seed, feed, and waste are excluded.

thought of as temperate crops are also important; approximately 30 per cent of the tobacco, cotton, and corn is produced here. Even 8 per cent of the wheat production is found in countries lying in this belt.

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The tropical area accounts for almost one-fifth of the value of total world trade. This proportion is higher for agricultural products. Outside of the typically tropical products, this region plays a significant role in world trade in many other agricultural commodities. Two-thirds of the world's rice and sugar exports, 40 per cent of the cotton, and more than a third of the tobacco come from the area. Tropical countries also are important markets for some of these same products, taking over half of the rice import, 15 per cent of the sugar and one-tenth of the cotton and tobacco. The most important agricultural import which comes entirely from the temperate zone is wheat (or wheat flour), with tropical countries taking one-fourth of the total trade.

### Economic Development of the Tropical Region

The awakening of the tropical zone is due partly to political reasons. Before World War II only four countries in the tropical belt, outside of Latin America, were independent nations. Since then 12 countries have achieved independence and several more will become independent within a few years.

Advancement is also being made in other than the political field. Because of improved sanitary conditions, better health facilities, and greater food supply, population has expanded rapidly. In the past 20 years population has increased almost 30 per cent, or about 1½ per cent a year, and this rate is increasing.

Most of these countries have become aware of the need for economic and social improvement, and many have embarked upon multi-year plans of economic development. These plans have as their general goal the more efficient utilization of human and natural resources and the raising of the levels of living.

In order to achieve this goal, ambitious programs for increasing agricultural production have been instigated. They include expansion of irrigation, increased use of fertilizers and insecticides, use of improved seeds, and mechanization. Some success has been achieved. Throughout the tropical zone there has been considerable increase in agricultural production, although advancement in some countries has been greater than in others. In 20 years, rubber production has increased more than 90 per cent, rice 40 per cent, and cotton and cacao one-fourth. There has also been significant expansion in tobacco and coffee.

An important purpose of these national plans has been to increase foreign exchange earnings to provide funds for further development. In

a large measure this was to be gained through increased production of agricultural commodities, both for export sales and for domestic consumption, the latter objective being to reduce import requirements, This expanded production would appear to have a detrimental effect on U. S. agricultural trade by increasing competition and reducing markets within the country. However, it has been the experience of most of these countries that as soon as they achieve some improvement in health, education, and income levels, the population and per capita consumption has gone up so rapidly that total consumption has outstripped the increase in productivity. Thus, much of the greater production which was designed for export has been utilized domestically and imports for consumption have increased instead of decreased. Therefore, U. S. trade with these areas has actually expanded because of their development programs.

The United States has taken a vital interest in the development of these countries. More than 30 countries in the area are receiving aid in their development programs through the International Cooperation Administration. Of the total funds expended by this agency in fiscal year 1957, over

60 per cent went to countries in the tropical region.

Because of increased total consumption, which has resulted in increased imports and caused exports not to reach planned levels, many of these countries have serious unfavorable foreign exchange balances. Public Law 480, by which the United States is authorized to sell surplus farm commodities abroad for foreign currencies, has come at an opportune time for many of these countries since it enables them to purchase in their own currency the extra requirement of food and fiber which their diminishing foreign exchange balances would not otherwise permit them to buy. Since the beginning of the program in 1954, 38 per cent of all of the sales of U. S. commodities under Title I of Public Law 480 for foreign currency has gone to countries in the tropical region.

A good example of the relationship of Public Law 480 to development programs is found in India. The first five-year plan was completed in 1956 and its major goal was to make India self-sufficient in farm products. Production of food grains was to be increased 14 per cent, cotton 42 per cent, jute 63 per cent, oilseed 8 per cent, and sugar cane 12 per cent. Food grain production exceeded the target level by 1954, and only jute and sugar failed to reach the goals by 1956. The first plan phased into a second five-year plan in which agriculture is also important but industrialization is given greater emphasis. Production targets in the second plan call for an increase of 28 per cent in the total annual output of farm

products by 1961.

This goal is rather optimistic. Some increase will be achieved but it may not be as great as that achieved in the first five-year plan. During the first f the in self-s food studi calor

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In spite of this expanded production, India has not been able to become self-sufficient in food and fiber. Consumption has gone up so rapidly that food imports have increased instead of decreased. Our food balance studies show that average daily food consumption has increased about 80 calories per capita over the past three years. This means less than an extra one-sixth of a cup of rice per person but for all of India an extra 5 million tons of rice per year is required. U. S. exports of food grains to India have increased 55 per cent over the past five years. A substantial amount of this has been moved under a Public Law 480 program. These supplies have had a strong supporting effect on India's continued economic advancement.

Agricultural Trade Between the United States and the Tropical Region

Of particular importance to us is the relationship between the world's tropical zone and the United States. What role does it play as a market for our agricultural exports and as a supplier of the products which we import? How do exports from this area compete with our farm production in the domestic market and in foreign markets?

Seventy-six per cent of our agricultural imports come from the tropical region. The value of these imports has increased to a level four times that of prewar. The increase in importance of this area as a market for our agricultural products is even more striking. The value of our farm exports to this region in 1956 were almost 12 times their value during 1935-39. The proportion of our total agricultural exports which this market represented increased from 10 per cent prewar to 22 per cent in 1956.

Our four largest agricultural imports come from this area—coffee, sugar, rubber, and cocoa beans. Other important imports include bananas, tea, tobacco, hard fibers, vegetable oils, and long-staple cotton. Our most important agricultural exports to this area include wheat and wheat flour, rice, fats, and oils, dairy products, cotton, and tobacco.

In 1956 over one-fourth of all U. S. exports went to the tropical region and over 40 per cent of our imports came from there. Volume of trade was more than six times the prewar level. Our imports from this area exceeded exports to the area by about one-third billion dollars.

It must be recognized that agricultural trade between the United States and the tropical area represents only one segment of the broader economic picture. Agricultural trade is closely interrelated with nonagricultural trade; therefore, balance of trade and dollar reserves of these countries cannot be considered independently for the agricultural segment.

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Competitive Aspects of Agricultural Trade from the Tropical Region

Some products of the tropical zone compete directly with U. S. exports in the European and Far Eastern markets. These include cotton from Latin America, East Africa, and India; tobacco from East Africa and India; and rice from Southeast Asia.

The tropical area supplies about two-fifths of the world cotton market. Exports of cotton from Central America have almost doubled in the past five years, and exports from East Africa and India have also shown significant increases. The U. S. share of the cotton market, which was 34 per cent in 1950-54, dropped to 18 per cent by 1955, principally because U. S. prices were not competitive in world markets. When U. S. stocks became available at competitive prices in the 1956-57 marketing year, the U. S. share of world trade jumped up to almost 50 per cent.

For the most part, cotton from the tropical zone is competitive from a quality standpoint with U. S. cotton in foreign markets. Substitution between the general types of cotton is made to only a limited extent, however, and some cottons, such as the extra long staple from the Nile basin and from Peru, the rough, harsh Tanguis variety from Peru, and the short staples from India are preferred for certain uses regardless of minor price discounts. The United States imports some cotton of these types.

The U. S. share of the world tobacco market has fallen from 40 to 30 per cent in the past 10 years. Two of the major contributors to this loss are the Federation of Rhodesia and Nyasaland, and India, where exports of flue-cured tobacco have more than doubled in the same decade and compete in the European market. The United States is also experiencing increased competition for burley, dark-tobacco, and cigar tobacco from the Federation and from Latin America. Even though there is greater competition from tobacco produced in some tropical zone countries, at the same time markets for our tobacco in other countries of this area have expanded substantially.

Although production of rice in the tropics has increased greatly since prewar, consumption has gone up at a faster rate both in exporting and in importing countries. As a result, this area actually has less than half as much rice to export as before the war while import demand is much greater. This has opened up new markets in the region for U. S. rice. Because of the virtually complete liquidation of rice surpluses held by Thailand, Burma, and Italy during the past two years, and a material reduction in U. S. government stocks, the competitive aspects of the rice trade have changed substantially. World export availabilities in 1958 may be somewhat less than potential import requirements. However, since U. S. rice prices are above the world level, the volume of U. S. ex-

ports will continue to depend largely on quality, price of competing cereals and the foreign exchange situation. The U. S. export surplus cannot be sold entirely for dollars but requires the use of Public Law 480 foreign currency sales.

Some other products of the tropical zone are less directly competitive but are in part supplementary to U. S. farm exports. Fruits and vegetable oils fall into this category. Some citrus fruits are exported from the tropical area and offer some competition to our exports, but the principal fruit exports—bananas and pineapples—compete only to the extent that a banana may be eaten in place of an orange or an apple. The U. S. is the major importer of bananas, practically all of which come from the

tropical area in Latin America.

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Peanut oil and peanuts from Nigeria, French West Africa, and India, and cottonseed and cottonseed oil from the Sudan and other countries in Africa, compete with U. S. liquid edible oils in the world market. The export of these oils has increased considerably in the past few years. However, the most important oils from the tropical region are of the palm group-copra and coconut oil, palm kernels and palm kernel oil, and palm oil. These hard oils make up more than 40 per cent of the world's vegetable oil trade. The palm oils, including coconut oil, are now being used extensively in Europe where they are combined with liquid oils in the manufacture of margarine. To some extent, therefore, they are complementary to the U. S. cottonseed oil and soybean oil exports. Within certain limits, however, they are also competitive since variation in price differentials leads to substitution of one for the other. These oils were formerly used extensively in soap manufacture in foreign countries, but the availability of large quantities of U. S. tallow at relatively low prices has largely replaced these oils in this industry. The United States imports large quantities of these oils, as well as castor oil, for industrial

Nearly three-fourths of the sugar supply of the United States is produced in the tropical zone. The U. S. Sugar act defines the manner in which the several producing countries shall share in the U. S. sugar market. The requirements of the U. S. market are allotted to the several domestic and foreign supply areas in the form of quotas. These requirements are determined by the Secretary of Agriculture and averaged 8.7 million short tons, raw value, during the most recent three-year period. The mainland cane and beet areas normally supply about 28 per cent of that total; domestic offshore areas in the tropics (Puerto Rico, Hawaii and the Virgin Islands) supply about 25 per cent; and foreign countries, primarily Cuba and the Philippines, the other 47 per cent. Cuba with average annual exports to the United States of 3,000,000 tons during the

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last decade is not only our most important supply area, but also supplies almost one-half of the world free market requirements.

Complementary Aspects of Agricultural Trade with the Tropical Region

In spite of the competitive aspects of some of the trade of the tropical region, the great bulk of agricultural exports from this area is complementary to U. S. farm production. These complementary products have a natural comparative advantage over other crops in the tropical area because they cannot be grown elsewhere in the world. However, lower world prices for these products could result in a shift of land resources to the production of crops which compete with temperate agriculture.

Coffee has the greatest value of any agricultural commodity in world trade. It is also the most valuable U. S. import, even exceeding petroleum in three of the last four years. The annual value of U. S. coffee imports is almost \$1.5 billion. The coffee industry within the United States, including processing and distribution, is estimated as a \$2.5 billion business. Coffee has been the favorite U. S. beverage for nearly 200 years and it is estimated that over 125 billion cups are consumed each year. Creaming agents in coffee alone account for the consumption of 300 million gallons of dairy products annually at a value of close to one-third of a billion dollars.

Other complementary products are also important in our trade with the tropical zone. Over \$400 million of rubber, \$150 million of cocoa beans, \$70 million of bananas, \$50 million of tea, and \$30 million of spices are imported each year. Most of our tea, spices, and crude rubber come from Southeast Asia and Africa. Cocoa beans come from Latin America and Africa. Practically all of the bananas and 80 per cent of the coffee come from Latin America.

Importance of the United States as a Market for Tropical Products

Many countries of the tropical region depend to a very high degree upon the export of one or two of these tropical products for their foreign exchange earnings. The United States takes more than 50 per cent of the total world imports of many of these commodities. This situation makes these countries highly vulnerable to price changes for their product and greatly dependent upon the U. S. market. This can be illustrated in the case of coffee.

World exports of coffee during calendar year 1957 amounted to about 37 million bags. The United States imported 21 million bags or 57 per cent of this amount. Last year Brazil produced 46 per cent of the world supply of coffee and the United States took 62 per cent of its coffee exports. Colombia, the world's second largest producer of coffee, sold 86 per cent of its coffee to the United States.

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More than 50 per cent of Brazil's total exports go to the United States and coffee represents more than 80 per cent of this trade. Coffee provided Brazil with over \$600 million from the United States in 1956. (This dropped 13 per cent last year.) Of Brazil's total dollar credits in 1956 she spent \$300 million to import U. S. products, \$42 million of which were agricultural products.

Columbia is even more dependent on coffee than is Brazil. More than three-fourths of its foreign exchange is earned by coffee. The United States took 68 per cent of Colombia's total exports in 1956, and 91 per cent of this trade was coffee. Colombia spent 84 per cent of its dollar earnings buying U. S. exports, compared to only 39 per cent for Brazil. This indicates a possibility for market development in Brazil.

The Central American countries of El Salvador, Guatemala, Costa Rica, and Nicaragua also depend upon coffee for more than one-half of their foreign exchange. Coffee makes up 86 per cent of the total U. S. imports from El Salvador, 83 per cent from Guatemala, 77 per cent from Nicaragua, and almost 50 per cent from Costa Rica. Thus, these countries also must sell us coffee in order to have dollars to buy our goods.

Between 75 and 90 per cent of our total imports from several African countries—Angola, Ethiopia, and British East Africa—are made up of coffee. However, these countries ship a large proportion of their coffee to other countries, particularly in Western Europe, and therefore are not as dependent upon the U. S. market.

Coffee is in serious difficulty today. Production has substantially exceeded effective demand. Since coffee is a tree crop, it takes several years to expand or diminish the supply. Also, in many areas where coffee is grown, there is little opportunity for alternative crops.

It is also difficult to adjust this imbalance of supply and demand by reducing coffee prices. Although the market for coffee is steadily expanding, the short-term demand is extremely inelastic. In 1957, when the New York spot prices of coffee declined sharply, no appreciable increase resulted in coffee consumption. The average American loves his cup of coffee and does not do without it even at a high price. On the other hand, if it is offered to him at a low price it does not change his consuming habits appreciably. Also, there is no alternative use for coffee no matter how low prices may fall, except possibly for fertilizer. Years of research have failed to find economic uses as animal feed or as an industrial raw material.

The question arises as to the United States' responsibility in such a situation. We represent a large proportion of the market for this commodity, and at the same time it is important to the economic well-being of many producing countries. Should we assume responsibility or even take the leadership in finding a solution to this problem? Many of the

surplus producing countries feel that the United States should take a strong interest in the world trade of this commodity and should join with other major consuming countries in establishing an international coffee agreement, somewhat similar to the International Wheat Agreement or the International Sugar Agreement. Some believe that a national arrangement such as the Sugar Act would provide additional protection for usual U. S. suppliers. By this, Latin America would hope to stem our increasing trend of coffee purchases from Africa. As yet the United States has not been willing to enter into such an agreement. However, we have agreed to join in another study of the situation in hopes that helpful recommendations may be developed.

## Communist Penetration in Agricultural Trade of the Tropical Region

There is another aspect of this situation which should not be overlooked. The economic difficulties these coffee producing countries are having could provide an opportunity for the Communist countries to gain another foothold in free-world trade. In the past few years the Sino-Soviet bloc has had considerable success in using trade and trade agreements as tools for economic penetration of less developed countries. The bloc's trade with countries of the tropical region has increased steadily and substantially since the beginning of its economic offensive.

The bloc has made a point of helping countries which have virtually a one-crop economy and which periodically face export difficulties. Its purchases of export surpluses have often been at prices above the free-world market level, obviously uneconomic to the Communist countries. However, the products which the bloc has supplied in return are usually even higher priced, so the cooperating country has not come out ahead. Also, these commodities which the Communist countries have so freely taken often are resold at a lower price in traditional markets of the cooperating countries, adding further damage. In spite of these problems and the dangers of gravitating toward the Soviet orbit, the bloc's offer to take surplus agricultural commodities has been very tempting to a country worried about market outlets.

Both the Soviet Union and Communist China have purchased Burmese rice within recent years when Burma had marketing problems. Now that world demand for rice exceeds the supply, and prices have improved, Burma does not have export difficulties and prefers to sell in the free world market. Since 1952 much of Ceylon's rubber has gone to Communist China in exchange for rice, which possibly came from Burma. Egypt's foreign trade formerly was principally with the West but has shifted sharply towards the Sino-Soviet bloc. More than one-third of its total trade was with the bloc last year. The Communist bloc achieved this advantage

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by offering Egypt a ready market for its surplus cotton crop, some of which reappeared in the European market. Russia's offer last year to buy a large part of Sudan's surplus cotton crop never materialized, but it did make important propaganda. Also, last season Russia purchased a substantial quantity of cocoa beans from Ghana at a time when prices were at their lowest ebb. Soon afterward cocoa prices went up though not because of this one purchase; nevertheless, Russia has claimed the benefit.

Latin America is one of the prime targets of Communist penetration, and the present coffee situation provides an excellent opportunity for the kind of trade deals in which Russia has become proficient. An agreement has been made to exchange some of Columbia's coffee for Syrian wheat. There have even been preposterous suggestions that the Soviet Union would be willing to take all of Brazil's surplus coffee. This is not believed by anyone, of course, especially since Russia is not a coffee but a tea drinking country. However, such a proposal makes excellent propaganda in Brazil in view of the difficulty it is having in selling its surplus coffee.

#### Conclusions

In conclusion these points may be emphasized regarding the agriculture of the tropical region:

1. This vast area represents an important segment of world agricultural production and trade.

2. Agriculture in this area is largely underdeveloped. Development programs have been established in most of these countries, however, and the agricultural revolution is under way.

3. Tropical agricultural production is not keeping pace with expanding consumption which results from population increases and higher levels of living. Therefore, a large part of this area will be deficient in food supplies for several years and will require an increasing volume of agricultural imports from temperate zone countries, especially the United States and Canada.

4. Consumption of U. S. agricultural products has expanded rapidly in this area and will continue to increase in the next few years. Commercial sales of U. S. farm products are limited by prevailing dollar shortages. However, sales of surplus commodities for foreign currencies can continue to be an important development factor by enabling countries short of foreign exchange to bridge the gap between their domestic demand and their foreign supply. As these countries develop their resources, they may earn the necessary foreign exchange to pay for their expanded agricultural imports.

5. Some agricultural products from the tropical area compete with U. S. farm exports in the world market and are supplementary to some U. S.

farm products in our domestic market. However, the bulk of agricultural production from the tropical region is complementary to U. S. production and trade.

6. Complementary products from the tropics play an important part in our economy and way of life. More than three-fourths of our agricultural imports come from this region. Our purchases of agricultural products from these countries provide them with the dollars needed to buy from us.

7. Since the United States constitutes the major market for many products which are important to tropical countries as foreign exchange earners, the United States becomes vitally concerned when a difficult situation exists such as now faces the coffee industry.

8. The continued existence of agricultural export surpluses, which are depressing the economies of several countries of the tropics, may provide increased opportunities for Communist penetration of free-world trade.

## DISCUSSION: TROPICAL AGRICULTURE—COMPETITIVE OR COMPLEMENTARY?

G. W. HEDLUND Cornell University

West has presented us with a rather general discussion under what I consider to be an unsatisfactory title.

My criticism of the title is that it is too broad and the question it raises is not very specific. As West points out, the tropical countries include 36 per cent of the world's population, 37 per cent of the total land area and more than 25 per cent of world agricultural production. Furthermore, it is a heterogeneous area including the wet tropics as well as highlands with a temperate climate. Political boundaries do not follow the Tropics of Cancer and Capricorn. This made it necessary for West to include large areas of India and Mexico which lie north of the Tropic of Cancer and to exclude a large part of Australia which lies north of the Tropic of Capicorn. He did this in order that he might marshall data bearing on the subject. I suggest that it might have been more fruitful to confine the subject to an individual country or to a group of countries possessing similar resources and climate.

The question raised in the title is far from clear. West interprets it to refer to the United States and Canada. I suspect that this is what was intended, but is it the extent of our interest? There must be some important competitive and complementary aspects as between tropical countries themselves. Finally, the subject could include the relation of tropical

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agriculture to our principal world adversary and the policy implications which this suggests. West's paper touched on this in relation to coffee.

All this may merely point out the inconsistency of this reviewer. He suggests that the first part of the subject, "Tropical Agriculture," is too broad, and the second part, "Competitive or Complementary," is too narrow if limited largely to the United States.

West's principal conclusion to the question suggested by the title is as follows: "Some agricultural products from the tropical area compete with U. S. farm exports in the world market and are supplementary to some U. S. farm products in our domestic market. However, the bulk of agricultural production from the tropical region is complementary to U. S. production and trade."

I do not disagree with this general conclusion. I wish that West had presented a more firm base for the conclusion. Perhaps this is expecting too much in a short paper with the material that West had at hand. During recent years United States trade has been influenced by many forces such as Public Law 480 and foreign aid in general. Hence, the recitation of statistics on trade and changes in trade between tropical countries and the United States is not an entirely satisfactory basis for conclusions.

I wish, also, that West could have investigated the competitive aspects of apparently complementary products. If the terms "competitive" and "complementary" are taken literally, I suspect that few products of the tropics fit exclusively into either category but lie somewhere in between strictly competitive and strictly complementary. West points out that some cotton produced in tropical countries is partially complementary. I suspect that there are those who would argue that even coffee is partially competitive with milk and other beverages in spite of the extensive use of cream in coffee.

The inclusion of tropical agriculture under the general heading of World Agricultural Development implies some relationship to development. West has included a discussion of development in tropical countries. His principal conclusion of significance here is to the effect that development has resulted in greater expansion in consumption than in production of agricultural products. Consequently, these countries have increased their imports of agricultural products from the United States and will continue to do so in the next few years.

I am pleased that West included development in his paper. In fact, the title might well have focused attention on the production and trade implications of development rather than on tropical agriculture as such. I wish he could have made further analysis of the causes of greater expansion in

consumption than in production and of the means used to settle trade balances. More important, perhaps, are the longer-term implications of development on trade. West predicts that a large part of the tropics will be deficit in food supplies for several years and will require an increasing volume of agricultural imports from temperate zone countries, especially the United States. The implication is that this situation is temporary. This leaves the longer-term trade questions unanswered. Will development reduce our farm exports to tropical countries and will these countries in turn become more competitive with us in foreign markets? Or will development permit these countries to continue to expand their consumption of some of our farm products?

Finally, West points up current price and exchange problems of coffeeproducing countries, suggests that these circumstances open opportunities for Communist penetration and implies that the United States should take

appropriate action.

This is moving to the policy and political arena. I have no doubt but that such problems do and will exist. I admit essentially no knowledge of the coffee problem. On August 4, 1958, the wholesale price of coffee in New York was 46 cents per pound. Such a price is 400 per cent above the average price for 1935-39 and 64 per cent above the 1947-49 average. Current prices are substantially below prices during more recent years which reached their peak in 1954. By way of comparison, average prices received by U. S. farmers in July were 130 per cent above the 1935-39 level and 9 per cent below those received in 1947-49. I suspect there are many reasons why this is not a valid comparison. On the other hand, one of the problems of coffee is the fact that prices rose very high and are now reacting under the influence of larger supplies. No one, no country enjoys a falling price. One might inquire whether the problem of the price of coffee is any more serious than the problem of prices of domestic agricultural products generally.

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## MODIFYING MARKET ORGANIZATION AND PRACTICES

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Chairman: R. S. Elliot, Winnipeg Grain Exchange

## ALTERING MARKETING CONCEPTS TO MODERN CONDITIONS

PAUL E. NELSON, JR. \*

Denison University

POR many centuries most men believed the earth to be flat. Sincere and learned experts considered questioners of this precept to be heretics. Even Galileo was forced to recant. Today, however, social science scholars seek to discover "series of inter-connected concepts and conceptual schemes arising from experiment and observation and fruitful of further experiment and observation." They no longer maintain that "the world is like this or like that," but stress that "our experience to the present is best represented by a world of this character." Thus, with so changed a climate of opinion, a modern skeptic of existing economic doctrine may hope to receive a sympathetic hearing.

Concepts may require revision in two circumstances: (1) when defects are discovered within their internal consistency; and (2) when reality so changes that concepts cease to serve as a basis for explanation or description. By the end of Marshall's career the basic internal consistency of the classical system had been firmly established. Hence, any changes in concept now contemplated will stem primarily from alteration in the reality which the classical system purportedly describes and explains. This paper will attempt to ascertain which concepts need revision, and will propose a revised basis which may serve for developing systems of theory which apply to modern conditions. This analysis will focus upon changes occurring with (1) the firm, and (2) the market.

### The Classical Model

Classical theory relating to the behavior of the firm provides a conceptual system created to evaluate the performance of actual firms. Historically, economists have considered this model a solid foundation for analysis and for elaboration. An undetermined number of economists main-

<sup>•</sup> I wish to acknowledge the positive suggestions made by my colleagues Leland Gordon, Alpha Chiang, and Andrew Sterrett.

<sup>&</sup>lt;sup>1</sup> James B. Conant, Modern Science and Modern Man, New York: Columbia

University Press, 1952, p. 54.

<sup>2</sup> Herbert Dingle, "The Scientific Outlook in 1851 and in 1951," British Journal for the Philosophy of Science, II.11.98-99.

tain that sufficient "competition" remains to justify this model as a continuing approximation of reality.

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Characteristics explicitly attributed to the firm by this classical model include (1) size, sufficiently small to guarantee that each firm's actions can not perceptibly affect the behavior of the market, as reflected in the price, and the quantities made available for purchase and sale; (2) homogeneity of the commodities produced or the service rendered; (3) inability to establish artificial restrictions; (4) freedom of entry and exit; (5) price and profits as the major criteria for policy formulation; (6) knowledge, if not perfect, at least equal in quantity and quality on the part of all participating firms; (7) profit maximization; (8) the successful performance of such firms, which will automatically assure an optimum allocation of resources, and long-run efficiency.

Equally important, and not so obvious are characteristics implicitly attributed to the firm. These include the concept of the firm as a single proprietorship, or at most a simple partnership; the idea that maximization of profit in the short run will result in profit maximization during the long run; the idea that decision formulation essentially is a one man function, and except for general market forces, or acts of God, each entrepreneur has the capacity to implement his decisions in the internal functioning of his firm; (4) treatment of the firm as an organization for exchange which has production costs, but few if any sales costs; (5) subdivision of total costs into categories of fixed and variable with little attention paid to the dynamics of changing proportions between fixed and variable costs; (6) constant costs are assumed to be an unusual phenomenon; (7) government is relegated the contributory functions of the provisions of law and order, protection of property rights, and the enforcement of contracts; (8) the population is assumed to be a growing one; some economists were Malthusian in emphasis while others followed Godwin in spirit if not in logic, but the assumption of a continuous growing population was assumed by the majority; (9) bookkeeping, inventory control, etc., were considered part of the entrepreneur's duties, or his partner's, and were assumed to be elementary in complexity.

### Changes in the Firm

Classical microanalysis of the firm rests upon these assumptions. Its relevance for modern conditions is contingent upon how economic institutions and their practices have changed since 1900. The fact that modifications<sup>3</sup> contributed by Chamberlin, Robinson, and Nicholls, et al., were

<sup>&</sup>lt;sup>a</sup> For example: "Whenever under conditions of imperfect competition produces enjoy freedom of entry into the market, a no profit, no loss equilibrium will be established, one characteristic being that each firm operates at less than at optimum size."

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so readily received suggests that important alterations had appeared as early as 1930. Without becoming immersed in historical detail, a few comparisons of census data empirically will support this contention and demonstrate that these developments have continued, and are continuing. These census data provide a broad picture of the change in the size and organizational composition of food and fiber manufacturing businesses. Table 1 presents the percentage of establishments reporting the indicated average number of wage earners for the U.S., and for selected catagories, for the years 1905, 1929, 1954. A precise comparison is impossible because of census shifts in its reporting base during the period covered. However, for our purposes these data demonstrate the basic increase in the size of firms during this period.

Table 2 presents data concerning the form of business organization prevalent during 1905-1954, and the percentage of either value of product or value added<sup>5</sup> attributable to corporations, and to multi-units, including both corporate and noncorporate. In the case of the corporate figures for butter, cheese, and concentrated milk, the census data did not identify how many of the cooperatives which were reported as an entity were corporate. They were not included in the census corporate tabulation, so arbitrarily two-thirds of the cooperatives were added to the corporate total in computing the percentage for this category. This two-thirds is an approximation supported by experience with information concerning cooperatives.

Table 3 presents concentration ratios computed both upon a product and industry classification basis for the largest 4, 8, and 20 companies for 1954, for food and kindred product industries which, with the exception of two additions, approximate those appearing above.

These tables<sup>6</sup> speak for themselves. It is evident that the greatest expansion in the size of individual establishments with 21 wage earners or above, came from 1929 to 1954. However, 1929 data, when compared to 1905, establish the early development of this trend. Undoubtedly these empirical data when combined with information concerning the rapid adoption of the corporate form of business between 1905 and 1929 stimulated Chamberlin et al. By 1929 the listed industries all were characterized

 $<sup>^4</sup>$ The two systems are: (0) (less than 5) (5-20) (21-50) (51-100) (101-250) (251-500) (501-1,000) (over 1,000) and (1-4) (5-9) (10-19) (20-49) (50-99) (100-249) (250-499) (500-999) (1,000-2,499) (2,500 and over). The compromise adopted to unite the two series is (less than 5) (5-20) (21-50) (51-100) (over 100).

Value of product for 1905 and 1929; value added for 1954.

<sup>&</sup>lt;sup>6</sup>Tables 1 and 2 are based upon data appearing in the Census of Manufacturers for the years 1905, 1930 and 1954. Table 3 and other concentration figures are taken from Concentration in American Industry, Report of the Subcommittee on Anti-trust and Monopoly to the Committee on the Judiciary, U. S. Senate, Eighty-fifth Congress, First Session.

TABLE 1. PERCENTAGE OF ESTABLISHMENTS REPORTING THE INDICATED AVERAGE NUMBER OF

		F	er cent	of estal	blishme	nts witl	ı an ave	erage n	umber o	f wage	earners	amoun	Per cent of establishments with an average number of wage earners amounting to-		
	Les	Less than five	ive		2-30			21-50			51-100		Mo	More than 100	100
Group	1905	1929	1954	1905	1939	1954	1905	1929	1954	1905	1929	1954	1905	1929	1954
U.S.	44.3	48.9	87.8	31.2	25.4	31.9	12.8	11.9	14.9	8.8	5.9	7.4	6.4	7.9	9.6
Food and kindred products	72.4	67.7	33.4	18.1	21.3	84.4	4.5	6.5	16.0	9.6	4.9	8.0	4.9	2.1	8.0
Tobacco*	72.2	56.6	85.4	1.03	16.4	21.5	4.1	6.6	7.7	1.5	6.6	7.7	2.1	13.8	7.72
Textiles	13.5	8.7.8	15.7	86.8	31.5	24.0	94.0	17.6	19.4	16.9	9.5	18.1	17.4	13.6	8.72
Cotton goods	1.6	9.00	n.a.	4.9	6.9	n.a.	8.7	7.9	п.а.	15.8	13.7	n.a.	0.69	69.0	n.a.
Woolens	13.6	9.8	;	16.8	10.4	;	16.9	15.9		19.6	21.8		88.1	48.1	
Worsted	0.9	8.8	0.11	6.9	8.9	11.7	13.7	13.1	16.0	15.0	11.7	9.0	64.2	65.6	52.3
Butter	n.a.	88.8	45.2	п.а.	12.2	84.8	п.а.	4.0	13.0	n.a.	0.1	5.5	n.a.	++	0.2

\* Includes only snuff, chewing, and smoking.
† Butter, natural cheese, and condensed milk.
† Less than one-tenth of 1 percent.

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Table 2. Forms of Business Organization Reported as the Per cent of Establishments Which Possess Corporate and Non-Corporate Forms; Percentage of Value of Product Attributable to Corporate Establishments, and to Multi-Unit Establishments, Both Corporate and Non-Corporate, in the U. S., 1905, 1929, 1954

			Per	centage o	f			
Group	Corpora	ite establi	shments		tal value attribut orporation	able to	ets Munits	
	1905	1929	1954	1905	1929	1954	1954	
U.S.A.	23.6	48.3	52.3	73.7	92	94	68	
Food and kindred products	13.5	n.a.	51.4	67.8	n.a.	89	65	
Tobacco (smoking, chewing, snuff)	29.3	39.5	63.0	92.3	97.5	n.a.	n.a.	
Textiles	24.2	n.a.	77.2	59.1	n.a.	n.a.	n.a.	
Cotton goods	81.7	92.7	92.8	93.0	92.7	n.a.	n.a.	
Woolen Worsted	44.4 58.0	80.9 87.5	89.3	71.8 78.0	94.4 94.7	n.a.	n.a.	
Cheese, butter, and con- centrated milk	15.5	54.5	57.6	36.4	82.7	n.a.	n.a.	

by the corporate form of organization. The smallest extent of adoption was in snuff, chewing, and smoking tobacco where 40 per cent of the establishments were corporations. The manufacturing industries as a category maintained 48 per cent of their establishments as corporations. By

Table 3. Share of Product and Industry Shipments Accounted for by Largest Companies, 1954

	Total	Concentration ratio: Per cent of value of shipments accounted for by:							
D 1	number		4	1	8	20			
Product and industry class	Companies		Largest companies						
	Industry	Prod- uct	Indus- try	Prod- uct	Indus- try	Prod- uct	Indus- try		
Creamery butter	1172	14	16	19	24	28	34		
Natural cheese	1220	23	25	28	80	35	39		
Concentrated milk	166	43	55	52	68	62	80		
Tobacco (smoking, chewing, snuff)	58	56	58	80	82	99	99		
Cotton-broad woven-fabrics	418	17	18	26	29	45	49		
Woolen and worsted fabrics	285	25	27	34	38	52	55		
Canned fruits and vegetables	1461	39	28	48	39	56	52		
Meat packing products	2228	28	39	38	51	50	60		

1954 the smallest category for all industries was food and kindred products, with 51 per cent. Of even greater importance was the concentration of productivity in the hands of a few establishments. In 1929, for the U.S., 48 per cent of the establishments which were corporations accounted for 92 per cent of the value of product produced. By 1954, 52 per cent which were corporations accounted for 94 per cent of the value of product produced, and multi-units, including both corporate and noncorporate, accounted for 68 per cent of the value added. In the food and kindred products category, 51.4 per cent were corporations and acounted for 89 per cent of the value added, and the multi-units, accounted for 65 per cent.

Furthermore, by 1954, the *largest twenty companies* in each food and kindred product industry (measured by product class) accounted for 33 per cent or more of the value of shipments of the industry, for 98.7 per cent of the 154 listed food and kindred product industries. In each of these industries the largest 20 companies accounted for 50 per cent or more of the total value of shipments, in 82 per cent of the listed industries.

Although these alterations in the size and organizational format of a majority of establishments will markedly affect the reality of our inherited classical model, other changes, likewise, will directly affect the reality of this model. Among these are: (1) changes in technology; (2) the appearance of quasi-fixed costs (e.g. budgeted research and promotional expenditures) which alter the basic proportion of total costs attributable to fixed and quasi-fixed costs; (3) the location of decision formulation, and the responsibility for its implementation, as well as the necessity for the creation of intrafirm communication systems; (4) the increasing emphasis away from product, to appraisals of competitors' current behavior and projections of their anticipated behavior; (5) governmental regulations which range from commodity inspection, grading, and employment practices, to the form and extent of permissible business ownership; (6) the adoption of widespread product differentiation; (7) size, age, sex, and ethnic composition of the human population, and in the case of durables, the age structure of the existing population. Those developments which particularly pertain to the internal operations of the firm will be discussed first.

In this paper the concept, technology, includes developments which are organizational in character, as well as those which are mechanical and chemical. Improvements in any one of the three areas will result in changes in the company's cost structure, and changes in variable cost have been treated extensively by our inherited theory. Changes which relate to alterations in the proportion of total costs attributable to fixed and quasi-fixed costs have not been as thoroughly discussed. Changes

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which emphasize fixed and quasi-fixed costs by increasing the proportion of total costs which they represent, exert a real impact upon the internal operations of the firm. Their increase in proportion to total costs implies that entrepreneurs have less control over production scheduling since there is less scheduling flexibility available to them, particularly during the short run. Management also becomes more vulnerable to demands of organized labor, up to a point where the jobs which actually control production are so few and so elementary or mechanical in character, that the supervisory staff can run the entire factory in an emergency. The historic trend has been to increase the proportion of fixed costs to total costs. Thus, salaried personnel have increased by 37 per cent since 1947 in the food and kindred products industry; industry budgets for research have risen by 3 billion dollars9 from 1941 to 1954; and advertising, which forms one segment of total promotional expenditures, rose from 542 million in 1900 to 9,029 million in 1954.10 When company retirement commitments are added to such expenditures, along with federal Social Security liabilities, the modern manager has a great deal of money committed which must be spent, even when no sales revenue is forthcoming. When the capital outlays for automation are added to these other fixed expenditures, we can understand why managers feel their extent of management flexibility of operation has been curtailed. Thus, the flexibility of management, which is a tacit assumption of the classical school and to a large measure of Chamberlin et al., needs reformulation.

The classical model shows companies whose management is highly efficient in production, and the market tacitly is assumed to absorb this production. The Chamberlin, and related approaches, stress sales costs and have accomplished much along these lines, although more work is appropriate. However, neither model attacks the problem facing the large multi-unit company, corporate or otherwise, of where to locate the power and responsibility for formulating and implementing basic decisions and the consequences of such a decision. The entrepreneur of the classical model

<sup>&</sup>lt;sup>7</sup> For example, petroleum refiners and bakeries that employ continuous processes such as the Wallace and Tiernan.

<sup>&</sup>lt;sup>8</sup> Imogene Bright, "Changing Composition of The Labor Force in The Food Manufacturing Industry," Marketing and Transportation Situation, July, 1957, p. 16.

<sup>8</sup> H. S. Turner, "How Much Should a Company Spend on Research?" Harvard

Business Review, 32:101-107, 1954.

The printer's Ink, August 24, 1956, pps. 40-41. It also has been noted by some business executives that while they recognize that they are overspending upon advertising, they don't know which spot to cut back. Nelson discovered that the relationship between increments and decrements in advertising expenditures and sales revenue, lagged a year, for companies among the 100 largest advertisers, with one exception, was significant at the 1 per cent level. However, in four out of the six the relationship was inverse. See "Quasi-fixed Costs and Their Impact," Agricultural Economics Research. July, 1958, footnote 6.

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is an inner directed, one-man army analogous to Daniel Boone, whereas the modern multi-unit firm is more akin to a division of the army with its highly structured staff composed of "other-directed" officers. The plural istic character of the modern multi-unit concern exerts two types of influence, overhead costs, which Clark treats, and the loss of the keen edge of such economic tools as marginal analysis, such as Boulding discusses, While executives will be better administrators if they "think marginally," it is not possible to maximize in any precise manner the conglomerate of objectives of the modern concern which are themselves not rigorously defineable. Perhaps the best theory can do is to attempt to discover various ratios, such as the rate of return to entrepreneurial capital, which will substitute.

Recognition of intercompany influence or potential influence is a central tenet of imperfect competition theory. Worcester, <sup>12</sup> Cyert and March<sup>11</sup> provide insights concerning why dominant firms under imperfect competition tend to decline, and the impact of organizational factors, e.g. the budget process, under oligopoly.

Revisions of the classical model necessarily must incorporate the assumption of government regulation and its impact. Such regulation has an impact upon the behavior of the firm by compressing the range within which management possesses decision-making power, by establishing greater inflexibility of the entrepreneurial decision-making process, and by adding to the costs of the firm.

## Changes in the Concept of the Market

Product differentiation offers a stepping stone from the consideration of the firm, to the appraisal of the market as a concept. This concept of product differentiation has been a primary characteristic used to establish the existence of monopolistic and imperfect competition. Once permitted entry through the theoretical doorway, this concept both has assisted and inhibited theoretical analysis. It has helped in that its practice by firms forced a reconsideration of the classical model with the model of Chamberlin et al. being the result of such reconsideration. It has hindered, possibly by exerting too great an influence and at times establishing straw men for economic jousting. It injected certain moralistic issues which at times have clouded economic analysis and diverted energies away from

<sup>&</sup>lt;sup>11</sup> K. E. Boulding, The Skills of the Economist, Cleveland: Howard Allen, Inc., 1958, pps. 42-66.

<sup>&</sup>lt;sup>12</sup> Dean A. Worcester, Jr., "Why 'Dominant Firms' Decline" The Journal of Political Economy, Volume 65, Number 4, pp. 338-346

cal Economy, Volume 65, Number 4, pp. 338-346.

<sup>13</sup> R. M. Cyert, and J. G. March, "Organizational Factors in the Theory of Oliogopoly," The Quarterly Journal of Economics, Volume 70, February, 1956, pp. 44-64.

items more central in importance. It also has raised the continuing controversy concerning what a market is.

Cochrane, Papandreou, and others, have recently done much to clear away some of the confusion accompanying this controversy, by defining a market "to consist of buyers and sellers whose transactions involve products which functionally are essentially the same, whose production processes and marketing practices are basically similar. The test of the products being functional substitutes rests in the cross-substitution of commodities between firms as the price of the differentiated product of the one firm changes and the other remains constant. The industry then is composed of a group of firms in which technological decisions, market decisions, organizational decisions of the firms in question display a similar structural pattern." Cochrane then goes on to outline several models of imperfect markets. His model breaks away from the definitional impasse of previous attempts such as Triffin's. However, does he go far enough?

As census data show, both upon product and industry classification bases, more and more multi-unit companies cross industry lines. While the Ohio Blue Match company is commonly considered to be a match producer, it simultaneously became a large fruit and vegetable processor by merger with the Hunt Company. Possibly Ohio Blue Match can be divided by establishment to fit into as broad a set of categories as Cochrane has established, but can others? And even so, is this sufficient? In many of our analyses must we not focus upon the transactions made by companies regardless of industry? In short, while Cochrane and others make a contribution in their approach, and much more work challenges us, we need also to break away from a pure industry concept and ask what are the symmetries and cliques of companies which deal one with another? Does the frequency with which various companies have transactions with one another indicate more than a chance relationship? If so, is there a quantitative approach which might provide some index of relationship which would indicate dominance by certain individual companies or groups of companies, regardless of the specific product by which they are known? Actually, this approach could likewise be used within the Cochrane system to determine a sociometric pattern of transaction relationships. While Sterrett and I have only begun work upon such an ap-

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<sup>&</sup>quot;Willard W. Cochrane, "The Market as a Unit of Inquiry in Agricultural Economic Research," *Journal of Farm Economics*, February, 1957, pp. 21-39. Cochrane adds that they also are essentially similar in their business organization. This I am not certain is necessary. Does not a multi-unit company that is unincorporated, say a partnership, equivalent in size and function to a corporation, face the same economic and communication problems, etc?

proach, already we believe there may be some interesting results,

Certain assumptions are of course necessary: (1) The population of firms be functionally homogeneous, i.e., they are buyers and sellers; thus, the Cochrane model would meet this point. (2) No assumption is made concerning the degree of competition of the companies under scrutiny. (3) In a squared matrix assign the element A<sub>11</sub> is given the value "I" if company i completes a transaction with company j, and an "0" if it has no transactions, etc. (4) A matrix element is designated as a transaction element "I" whenever the table of random numbers shows an even number, and as a non-transaction element or "0" whenever the table shows an odd number. (5) The companies do not buy or sell from themselves. (6) Time is static in the sense that conditions assumed prevail throughout.

By establishing a matrix, say eight by eight, or 20 by 20, etc., and by using a table of random numbers, the random pattern of transactions may be established if 1,000 or more instances are tabulated and summed in a frequency distribution.

Then, with a Cochrane model, utilizing data from the real world, it may be possible to ascertain whether or not the numbers of symmetries or the number of cliques could have arisen due to chance. For those which are determined to be other than chance additional analysis will be needed. However, if sufficient data are cataloged it may be possible to develop an "index of imperfection" based upon the extent to which a group departs from chance.

In the case of an approach by other than a Cochrane category, there would be a listing of companies by size so as to have a homogeneous group in respect to assets, sales, promotional expenditures, etc. The point made here is that both approaches are necessary to completely describe the real world of today and tomorrow.

Whenever market analysis is considered usually the establishment of a demand function is one aspect which captures the interest of both theoretical and applied economists. The classical model assumes the human population to consist of the total number of bodies to be fed, housed, and clothed, etc. Little differentiation according to age is made, although ethnic difference receives some attention. Only recently have demand functions begun to incorporate the population in terms of the frequency of specific age groups, and of equal importance for durables, the frequency distribution of the existing population of durables. Admittedly, durability is not the primary problem for most agricultural commodities, which it is for autos, although the sharp decline in the prices of canned fruits and vegetables immediately following World War I may have been more closely related to such a phenomenon than historically has been appreciated. With frozen fruits and vegetables becoming an increasingly

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important component of the food product mix, it may well be appropriate to include the size and frequency distribution of the age of canned and frozen stocks in forecasts of demand more explicitly than they have been previously. Demand forecasts for fiber products likewise could utilize such parameters in their equations. The concept of what composes the population of the consuming market is more complex than classical economists assumed.

### A Revised Basis for Theoretical Schema

In summary, it is appropriate to utilize the above analysis to create a more exact image of reality than the one received from the classical school and in certain details, from the economists of the past two decades. The concept of the modern establishment includes the following characteristics and practices. It maintains 21 or more wage earners, 32 times out of 100, and accounts for approximately two-thirds of total value added. Fifty-two times out of 100 the establishment is a component of a corporation, and corporations accounted for 94 per cent of the value added. Eleven times out of 100 it will be a member of a multi-unit company. These multi-units accounted for 68 per cent of the value added. If it is a member of the food and kindred products category, it will find that the 20 largest companies account for 33 per cent or more of the total value of shipments, in 97.8 per cent of its component industries, and for 50 per cent and more for 82 per cent.

These size and organizational characteristics will encourage the typical firm to be quite responsive to the actions of its competitors, and to its own projections of anticipated actions of these competitors. It will tend to differentiate its product, and will use size and form of packaging as competitive techniques. In fact, its price competition will increasingly be cloaked by promotional claims of quality, and by presentation of its product in a variety of package or container sizes, usually in odd pounds and ounces.

In addition, it will divert resources from dividends to foster market research, and product development. It knows that it has a real advantage in possessing an inventory of market information which is more extensive and of a higher quality than its competitors. In making its decisions it will no longer rely primarily upon price and profit information in isolation, but will interrelate such information with other items, such as its probability estimate of government intervention, provided certain competitive actions are initiated. In making these decisions it will attempt to maximize long-run gains, and will not be surprised that such maximization may involve short-run losses. Long-run gains is a concept which is a conglomerate composed of a multitude of specific objectives, such as maximum

profits, domination of a specific market or industry, the successful establishment of institutional barriers to entry, the assurance of the quality of inputs, and the maintenance of production schedules. This conglomerate will be weighted differently by each company, and by each generation of executives.

Of necessity the company will find it must spend increasing resources to improve its own intracompany communication system. This will involve the addition of administrative and clerical and statistical personnel, and data processing equipment, thus adding to fixed costs as described above. It will constantly experiment with its own organization. It will try various systems of organization and locations of decision making authority, and its success here may well determine its very existence, as such success is becoming more important than the slight improvements in product quality technologically available during the short run. In this struggle for existence it will attempt to spread its vulnerability by becoming a multi-product, a multi-industry enterprise.

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This is the modern company. The modern market within which it operates is far more complex than the market portrayed by our predecessors. It is composed not of people at large, but by a population frequency distribution of age, sex, and ethnic inheritence. It is characterized by existing goods in the hands of consumers which possess varying degrees of durability, and are characterized by a frequency age distribution of their own.

The market also is not sovereign unto itself. It is forced to operate within limits established by governmental edict. In the future such governmental control will become more pervasive, in part as a result of actions by the companies themselves. For example the day may come when companies are limited to containers which are binary divisions of the pound, etc.

The market appears destined to be composed of companies which straddle not only markets but industries, as they seek the security assumed to be obtained by multiple product mixes, crossing industry lines. Such increasing complexity of market to market and industry to industry relationship will limit the usefulness of much of our existing theory. However, recognition of what reality is, and is becoming, is a necessary first step toward the construction of schema which adequately describe and explain the real world.

## DISCUSSION: ALTERING MARKETING CONCEPTS TO MODERN CONDITIONS

GEORGE W. LADD Iowa State College

Nelson has (1) outlined basic assumptions of the classical model, (2) enumerated changes in the firm and in the market which seriously reduce the usefulness of the model, and (3) outlined a revised basis for theory and indicated a number of pertinent variables and parameters which a comprehensive model must include. I agree with his thesis and with most of the details of his argument. I will then discuss a different but related matter—one of which I have become acutely aware.

This matter is a compulsion which agricultural economists seem to feel whenever they are meeting professionally, the compulsion to point out inadequacies of our economic theory. Many openly state their fears that it is outmoded, incomplete, inadequate, dead or dying as far as its fruitful application to real problems is concerned. Some few attempt to diagnose, to determine exactly what is wrong with this ailing corpus of economics. Fewest of all are those hardy souls who not only diagnose but who attempt to treat the ailing patient and to revive the corpus through injection of new ideas or new or revised conceptual schema. It is to this group that Nelson belongs.

The great majority of us, unfortunately, are in the first group. We are aware of ills affecting the body of economic knowledge and are unhappy about it, but we are not sufficiently unhappy to do something constructive. We do not like the patient to be so ill but we are too inert or preoccupied or lazy to take the steps necessary for successful treatment.

Economic theory is a body of ideas—of abstractions. As such, it arises from, and exists only in, the minds of men. Improvements in the theory also then arise from and exist only in the minds of men. Theory as such is inadequate only because man is inadequate, or because he is adequate but has not put forth the necessary effort. Looked at in this way it is clear that, when agricultural economists criticize their theoretical tools, they are criticizing themselves. If the tools are inadequate, why are they so? One important reason is that agricultural economists have not generally put forth the necessary effort to remove the inadequacies.

These facts, although perhaps painful and certainly not novel, do constitute a prerequisite to taking the necessary steps. First we must realize that something is *our* responsibility; than we can take steps to meet that responsibility. Fortunately, it is not all up to us; we have powerful help from mathematicians, psychologists, sociologists, general economists. But certainly some of the responsibility is ours. We cannot expect others to do all our work for us.

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For the benefit of those who agree that it is up to each and every one of us to attempt to remedy the weaknesses of our theory, included below is a list of references. It is not intended to be complete; it is only intended to be suggestive. There are some challenging and stimulating ideas in

these articles. Many of them can be useful to our profession.

For those who do not agree and who still insist on their right to bemoan the lack of usefulness of our concepts-a friendly challenge. Read the listed articles carefully. Then ask yourself this question: Are all my criticisms of economic theory justified? In many cases, I dare say, it will turn out that a complaint about economics was actually a tacit admission of failure to comprehend or even to keep up with developments in economics.

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See also the articles listed in footnotes 10, 12, 13 and 14 of Nelson's paper.

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D. B. DELOACH
University of California, Los Angeles

#### Introduction

Market organization is a reflection of the place people live, social customs, and the level of technological progress in the processing, transportation, and distribution of goods. As these forces change, market organization makes compensating adjustments. Conversely, changes in market organization and practices frequently induce changes of basic importance in the mode of living and social customs. The rapid pace of both production specialization and urbanization is being facilitated by the ability of the marketing system to organize and supply food, clothing, and other goods on a hand-to-mouth basis to the millions of people in metropolitan communities. Even the ethnic backgrounds of the people were recognized in organizing the food processing and distributing functions. Frequently this meant the development and maintenance of sources of supply of different types of products or products processed or handled in a manner to conform to the social customs of the people served.

The responsiveness of market organization to environmental conditions can be and often has been retarded by social customs and institutions in which people have a vested interest. Whenever such customs and arrangements are protected or encouraged by laws, contracts, or monopoly rights, the rate at which the marketing system adjusts its organization is measurably affected. This is well illustrated by the restraining legislation and special taxes on the sale of oleomargarine to protect butter producers, arbitrary barriers to the right-of-entry into markets within and between states, and minimum price laws on food and labor coupled with maximum working hours and other arrangements governing the flow of products or services.

The technological innovations that influence market organization fall into two categories, namely, (1) those affecting the physical aspects of the product or the manner in which it is processed, packaged, stored, transported, or merchandised; and (2) managerial techniques for organizing the resources used in processing and distribution, including the frequency and conditions under which the title to goods is transferred. In the main, the facilities, plant layout, and other physical aspects of technology are concerned with altering or maintaining quality characteristics of food by preserving, prepackaging, handling, and transportation methods that

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alter the distance-time variable as a factor in the marketing of perishable items, or make them more convenient to handle. The technology of management encompasses the techniques for controlling the use of resources in processing and distribution. Within this framework would be (a) the selection of the form of business organization through which management works to attain its objectives; (b) the development and maintenance of a system of records and a flow of information for managerial control; and (3) the procedures for making and executing decisions relating to the scope and scale of business operations, types and kinds of products, procurement policies, and sales programs.

There is a good deal of "sunk" capital in market organizations, in terms of both physical facilities and personnel, adapted to specific types of business and operational methods. Nevertheless, there is a degree of fluidity within existing organizations that enables them to make adjustments to meet the changing conditions of competition and the requirements of their business operations. The fact that business generally is organized to meet the stresses of competition is one reason that the rate of change in our American marketing system and its organization has been so rapid. The purpose of this paper is to examine some of the changes in the food marketing system, the manner in which market organizations have adjusted to changing practices and the requirements of buyers and sellers, and the extent to which the marketing system induces changes in the living and consumption habits of the people served. From this base, an effort will be made to anticipate future organization adjustments that might better meet the needs of producers and consumers.

## The Supply Function

Essentially, the marketing system's only function is that of supplying goods and services to consumers. The size of this task has been increasing, the rate of increase paralleling the growth in labor and product specialization, population, and urbanization. Arguments might be advanced that the system creates or stimulates demand because of the form, manner, or conditions under which goods are offered to consumers. This is true. However, the demand stimulating function will be regarded as a part of the supply function in which various agencies are competing for the available market. Inasmuch as the population complex is evolving from one level to another, its requirements for food and the conditions under which food is supplied also are changing. This means that the marketing system and its organization must undergo adjustments to perform the supply functions to feed a growing, shifting population whose changing modes of living set up new food supply requirements to which the system must respond, the rate of response depending on the flexibility of the institu-

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The economic history of the United States discloses the rising dependence of the population on a marketing system, the organizational characteristics of which have varied considerably through the years. It is not too difficult to trace the increasing importance of the food supply functions. As the direct producer-to-consumer system broke down in urban areas because of its cumbersomeness, the system of supply was taken over by hucksters and locally established merchants. This change met one of the basic supply requirements-assembly of food from many nearby farm producers. As a supplement to their locally produced foods, hucksters and local merchants obtained condiments and a few semi-or-luxury items from importers and provisioners (wholesalers). With the growth of product specialization, the same cycle also characterized the development in rural communities as the farm became a less self-contained economic unit. The evolution of the marketing system and its organization during the last century appears to have centered around the wholesaler, processor, and integrated retailer in that order.

#### Wholesale Distributors

Food wholesalers occupied a particularly strategic position in our marketing system between 1890 and 1930. Their power extended back to the source of supply of fresh and staple items and forward to the retail food store which depended on them for regular deliveries of a wide variety of food and credit. The control of the wholesaler over sources of supply was challenged only by other wholesalers. Food processors were often financed or owned by wholesalers who marketed their products under the wholesaler's brands, this being the only channel open to small, poorly financed food processors.

The domination of the wholesaler in the food trade until about 1930 arose from (1) his control over a substantial part of the investment capital for the industry, (2) his ability to exercise some control over the quality of products offered for sale under his brand on which the retail dealers and the consumers learned to depend, and (3) his satisfactory performance of the very essential assembly function of bringing together at one point (usually railroad or port terminal cities) for distribution a wide variety of food produced at home and abroad. In other words the wholesaler was the center of the orbit around which all other parts of the food marketing system revolved. In its day, this power potential of the food wholesaler was a tremendous force in American life, perhaps, equally as great as that later exercised by the national food manufacturers and then the retail food chains.

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### Legal climate favorable

While food wholesalers grew relatively large and economically powerful, they did not run afoul of the Sherman and Clayton Anti-trust acts. Public attention was directed at the primary purchasers of farm products, such as the large meat packing corporations, who were beginning to challenge the power of the traditional wholesaler by expanding their manufacturing activities to include fruits, vegetables, and various other prepared foods, and in addition to establish direct wholesale relations with retail food dealers. A further factor that appeared to protect wholesalers against monopoly charges was that the firms were usually either owned by one person or were a partnership.

### Assemblers of products

The important wholesale firms were located at ports of entry from foreign countries, river or lake ports, or railway terminal points, the latter being the least important. All of this reflected the importance of transportation—water transportation—in our economic life. These port cities were the centers of population and the points to which producers sent goods, and the points from which goods were distributed to the hinterland. Whenever the wholesale trade developed to a point to strain the facilities of port-city wholesalers, sub-assembly points or wholesale-jobbers sprang up in inland cities to meet the needs for a regular supply of food products on which the retailer and the consumer could depend for quality.

Until the late 1920's the flour milling, fruit and vegetable canning, and dehydrating plants from which wholesalers obtained their major products were mainly small, specialized operators located in or near their source of raw material. The small size and geographical dispersion of the food processing operations magnified the importance of the wholesalers' assembly functions. At the same time, however, the problems of assembling food from many small processors for a rapidly growing, urban-type economy pointed clearly to a need for a change in the organization of our food processing industry. The limitations placed on processing plant efficiency by seasonality alone restricted managerial efforts to reduce costs. Wholesalers often encouraged processors to diversify their line. Some processors encouraged farmers to grow a variety of products that would flow into the cannery at different times, lengthen the canning season, more nearly utilize plant capacity, and improve the marketing position of the canners in dealing with the wholesale dealers. Through product diversification, canners especially began to work out some of the basic problems of as-

<sup>&</sup>lt;sup>1</sup> The Eugene Fruit Growers association, Eugene, Oregon, is one of the best examples of plant management and grower cooperation in simultaneously developing a fruit and vegetable supply and a cannery and dehydrating plant. By carefully scheduling the various crops, the plant can operate as many as nine months a year.

sembly and to lay the foundation for circumventing the wholesaler by selling a full line of food items directly to retail stores. The economic aspects of the processors' operations will be dealt with further on in this paper.

## Financial aid to suppliers

Prior to 1930 wholesalers were often the financial backbone of a growing food processing industry. The risk capital needed to finance such a novel venture as food canning usually was not available from regular lending agencies. During this developmental period for the canning industry wholesalers met the need for investment and working capital. By doing this, they established their sources of food supply for a growing population that was becoming more urbanized and more dependent on the marketing system for its food supply. The wholesaler as a successful risk-taker reaped the financial rewards that went with being successful in a useful enterprise.

## Developed quality controls

Through contractual arrangements with processors or ownership of the plants, wholesalers were able to exercise some control over product quality. While few uniform standards were developed by the canned food industry prior to 1930, certain objective criteria were usable as a basis for contracts. These rough quality controls permitted wholesalers to build up a reputation for selling quality food through the use of wholesalers' brands which were equally well known to retailers and consumers. For local wholesalers and jobbers who were too small to build a brand reputation, food brokers entered the buying and selling business in a big way. It is for this reason that many of the famous private food brands belonged to successful brokers who performed the major assembly function of getting supplies of uniform quality products from many small processors to sell to a large number of small retailers.

### Distribution to retail stores

The regular calls of the sales representatives of large food wholesalers were seldom regarded lightly by an enterprising retail grocer. The sales representative was a source of information on new products; he was a collector for the wholesaler who had extended credit to the retailer for 30, 60, or 90 days, or even until the retailer had sold his stock of goods and was ready to re-order; he made suggestions for increasing sales of slow-moving items; and he brought with his good business advice a wealth of good humor and human interest stories that went along with a man-of-the-world in a much larger world than we have today. The firm bond between the wholesaler or the broker-wholesaler and the retailer was based

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on the retailers need for supplies, services, and credit. It appears that the food business usually was not complicated by trade rebates, special discounts or other inducements until the cash-and-carry chain food stores began to encroach on established ways of trading and to develop a direct processor to retailer relationship.

## Decline in power of food wholesalers

The underlying factors causing the decline in the wholesalers' power over the processing and distribution of food were those that gave rise to a period of processor domination, namely, (1) product diversification and the use of new technologies by processors to obtain greater efficiency in processing and distribution, (2) the ease with which processors could sell directly to large mass-retail outlets whose purchases were usually much larger than most wholesale buyers, (3) the development of truck transportation, (4) the financial ability of processors to promote their own brands by directing their sales appeals to consumers, and (5) the availability of managers capable of operating a multi-unit or multi-product processing and selling organization.

### **Processors**

Direct supply contracts between food processors and federal agencies during World War I released many processors from the control of wholesalers. While the food processing industries had some severe set-backs during the depression following, they were on their way to bigger things.

The stimulating effects of World War I on the processing industry, the growth of large regional and national retail food chains which were going directly to processors to buy food in wholesale quantities further served to break the ties between the wholesaler and processor groups. In many instances, this break was made possible only as a result of the ability of the retail food chains to contract for a substantial part of a processor's output or to aid in financing his operations. The growth of the processing industry during the post-World War I years was aided by a shift of investment capital out of war-based industries to peace time industry investments. From the investment point of view, the food industries appeared particularly promising, and among other developments, corporate holding companies emerged as a major influence in financing and managing food processing and distribution firms. Population was growing rapidly, a movement of people from rural to urban communities was taking hold as a factor in our way of life, and the food industry was at the threshold of tremendous technological changes. With a more adequate supply of capital available to the processing industry, the competitive conflict between newer type chain retailers on the one hand and the independent retailers and service-type wholesalers on the other, the economic power in the food industry began to shift to the food processing groups, particularly the well-integrated, full-line food processors.

## Availability of managerial skills

The pre-eminent position of food processors following World War I came about largely from their ability to organize, finance, and develop a mass production system, and at the same time organize and maintain a mass selling and distributing program closely related to their production activities, which served better the requirements of retailers and consumers, for new products and services. The ability to organize, finance, and operate large, multi-unit food processing plants engaged in buying raw materials and supplying many kinds of manufactured food items was an especially important ingredient in the progress of the industry in this country during the 1920's. New managerial techniques were available to control production methods, costs, and labor performance within each plant and for the entire firm. These managerial skills were used to obtain adequate and regular supplies of raw materials for many small farms under contract or in the open market. Inasmuch as processors were usually making an effort to establish their reputation for selling a uniform quality product or products, raw materials buyers began to exercise a controlling influence over the kinds and qualities of raw material delivered by farmers. Because production schedules were developed to process a specified quantity of raw materials, the delivery of which was often contracted for, management introduced new sales techniques to keep sales in balance with production. One effect of this balancing operation was to attempt to establish contact with consumers, the purpose being to enable the consumer to identify the food item of a given processor by its brand label and to encourage repeat purchases.

## Product identification by processors

Proprietary-label or brand-using food processors began to dominate the food market in the mid-1920s. The advent of radio and its use as a promotional medium, together with newspapers and magazines, provided a means of communication between the food processor and the consumer that had a great influence on consumers' preferences for proprietary branded items and a resulting impact on the brands handled by the retail food store. Product differentiation on the basis of proprietary brands became an important competitive weapon during the post-World War I years, and with this development of promotional competition, processors began to seek ways to minimize the effects of large promotional expenditures on product costs and consumer prices. The most successful procedure was to maintain a high sales volume in order to spread promotional costs and overhead costs over a large number of product units.

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Size, operating time, and excess capacity

Although plant managers may have different short-time objectives, in the long run they try to optimize the size and operating time of their processing plant in terms of unit production costs and sales. Optimum plant or firm cost efficiency can be attained when the lowest unit cost is reached. Low production costs, however, are only one side of the operational problem. A perfect production program can lead a processing plant or firm into financial difficulties unless the production schedules are correlated with the sales program for the products.

Managers have two ways to effect a production-sales balance. One is to adjust production schedules to sales in existing processing plant or to adapt the plant size to output requirements if a new plant is to be built. These are practical solutions for processors whose production schedule is on a year-round basis. But seasonal operators, such as those found in fruit and vegetable canneries, usually have some sort of a contract with producers for their total crop. The producer delivers the raw material, it is canned, and the canner then seeks a market. The market may or may not meet the canners' expectations during the year. If it is not up to expectations, the canner is faced with an inventory problem of great importance. Such experiences alter the attitudes and expectations of canners for the following season and they frequently adjust or compensate for over-production in one year by reducing their operating time for the next. Efforts to effect such adjustments give rise to excess plant capacity, which also may be a problem of the entire industry.

A second type of adjustment for obtaining a production-sales balance is through promotional activities and/or price adjustments to stimulate demand. This amounts to programming sales and production at the same time. The introduction of sales quotas is not uncommon, the effect varying within a firm and among firms in the same industry. In following such sales programs, the costs of selling in a highly competitive market may become so high that any normal efficiencies in production are easily dissipated.

The need to maintain low unit selling and distribution costs is as important to the processor as to maintain low unit production costs. Furthermore, managers use much the same methods to achieve the lowest unit cost consistent with the quality and service involved. The most important method in both processing and distribution is that of maximizing the volume of product handled with a given amount of resources. On the production side of the equation, managers seek to use their management resources to operate a large number of plants, to lengthen the production season by introducing new lines of products, or by locating processing plants nearer to sources of supply of raw materials or markets, depending

on the relative cost-quality advantages in such locations. Economies of scale are achieved on the selling side in much the same way. New product lines often enable sales managers to distribute their selling costs over many instead of one kind of product. This is a particularly effective unit cost reduction device for firms that can spread their promotion, travel, and administrative overhead over a large volume of sales of a line of products, in the event that one product does not fully occupy the sales force. The multi-unit, multi-product, widely dispersed firm that has taken root in the processing field owes its existence equally as much to a need for volume and product diversification on the selling side as it does on the production side. Such diversification of products and dispersion of plant locations serve a distinct purpose in production. It also is a means of minimizing the selling risks inherent in the food processing business.

## Adjustments to new products

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sing ling The food processing industry has made three major adjustments in recent years, the effects of which have been rather far-reaching. One has been the universal adoption of the consumer-sized, prepackaged unit to protect product quality, provide greater convenience in handling by retailers and consumers, and shift some of the retailer's prepackaging functions to the processing plant where they can be done on a mass production basis. Another has been the widespread introduction of scientific quality determination methods which give a better basis for quality control within a firm, even though there is no particular desire on the part of a given firm to adopt uniform state or federal grades. A more recent technological innovation that has shaken the processing industry considerably has been the rapid growth of the frozen food industry, especially the consumer prepackaged products.

There is not time here for more than a passing comment on the industry's ability to make the adjustments to the technological innovations mentioned above. The shift to consumer prepackaging occurred with amazing speed, even though it required some major readjustments in plants and equipment. The industry is still in a flux with respect to the best way to produce and market frozen foods. Locating and building plants, the determination of the number and kinds of products to freeze and sell, the acquisition of storage and distribution facilities, and problems of obtaining shelf-space in retail stores continue as unsolved problems.

Considerable progress has been made toward scientific quality determination and control. It appears that the food industry has accepted any worthwhile advance along this line. Furthermore, the industry's claims to raising the level of quality of products sold to consumers seem entirely justified. As a result of improvements in the methods of measuring various

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quality characteristics, and the development of specification buying by large retail food chains, processors who have relied on proprietary brands to control consumer favor now have their backs to the wall in competing with firms that sell to large retailers on a specification basis. The most immediate effects of the program of specification buying by large retail organizations have been to shift the basis of competition to price rather than to brands, and to stimulate the growth of small and medium-sized processors who could not seriously afford to promote their own labels on a national basis.

### Retailers

The shift in the economic power potential among wholesalers, processors, and retailers is a gradual process. Within our food supply system today are remnants of outdated wholesaling, processing, and retailing methods. They exist side by side with more modern methods and facilities largely because the operators have no alternative way to use their resources, their methods are well adapted to the community in which they operate, or they are held back by their own inertia. Furthermore, many of the operators consider their family-operated wholesale, processing, or retailing business a way of life in much the same manner that some farmers view their farming activities. Despite the existence today of the old and new in food processing and distribution, there have been some important strides toward a more efficient system of processing and distribution. These changes have not occurred without affecting the vested interests of the various groups in the food industry. The small, independent retailer has been hit the hardest.

The rising power of the large, retail food chains (corporate and voluntary) and supermarkets might be regarded as an adaptation of market organization to the requirements of an urban society which is undergoing changes in the location and composition of its population, and modes of living. Changes in consumer requirements are reflected immediately in their purchases in retail food stores. Alert managers sense these changes and continually adapt their operations to meet them.

## Urban living changes requirements of consumers

Consumer dependence on the retail store for each day's food supply grew rapidly with the shift of population from rural to urban areas, work specialization, and a regular weekly cash income for most workers which altered consumer food shopping habits materially. Retailers adjusted their merchandising methods to cope with hand-to-mouth buying. Efforts were made to offer consumers the size of unit that would be most convenient to carry and fit into the home storage space and various merchandising techniques were introduced to encourage "impulse" buying along

with the purchase of staple foods. This was accomplished by store layouts which routed the customer by all of the store's merchandise before she could get to the check-out counter. To cater to consumers who did most of their shopping on Friday and Saturday (pay days), facilities were developed to care for the two-day peak trade-load which averages 60 to 70 per cent of the total weekly volume.

The convenience to customers of store location changed greatly as automobile travel became part of our way of life and as credit-delivery shifted to the cash-and-carry type of business. The original efforts to locate a large number of small stores near their customers gradually gave way to the supermarket operation which depended on the convenience with which customers could get to the store by automobile and do most of their shopping for food and household wares. The net effect of all of these changes has been to re-create the "general" store in a modern form. The supermarket has become the center of "one-stop" shopping, especially in suburban areas.

## Maintenance of supplies for large retail stores

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When masses of people live and work in close proximity to one another there is a tendency for living habits to take on a rather standard pattern. Undoubtedly such standardization is partly affected by the physical problem of supplying large numbers of people with anything other than a standardized commodity, produced and marketed on a volume basis. Otherwise, urban living as we now know it would be a physical impossibility from the standpoint of supply alone. The fact that our American food industry has been able to organize to maintain an abundance of a wide variety of foods in every large and small community throughout the country is an unusual accomplishment.

The organization of the supply channels during the periods of whole-saler and processor domination of the food industry already has been discussed. There were no really basic changes in marketing or supply functions during the rise in power of the food supermarkets and chains. However, there was considerable adjustment in the conditions under which retailers could obtain their supplies. The ownership or control of retail outlets and the buying and selling practices followed by the managers of retail outlets is now having a marked effect on processing and distribution methods. The shift in emphasis from processors' brands to state or federal grades as a basis for purchase relieved the retailer of his dependence on any one supplier for a number of his products. Specification buying or buying on the basis of grades has become especially important for beef, fruits, vegetables, milk, and manufactured dairy products. When retailers buy on the basis of grades, they make it possible for any suppliers who can produce the grade of product in the volume re-

quired to bid on an order. While this gives an implication of a return to pure price competition, it is not the case. The ability of the retailer to buy on a grade basis is determined by his own facilities and organization for performing the buying and assembling services. Large retail corporate and voluntary food chains and supermarkets usually maintain the required organization and facilities; others do not.

## Cooperative and voluntary wholesalers' sales grow

Competitive conditions within the retail part of the food industry have stimulated sales growth among cooperative and voluntary wholesalers. By 1956 these two groups were handling 59 per cent of the wholesale food trade compared to 38 per cent in 1948. The share for the independent wholesalers was 41 per cent in 1956 and 62 in 1948. The two groups that did 59 per cent of the food business accounted for only 27 per cent of the total food wholesalers. Here, too, there is evidence of concentration.

While there may be some semantic argument as to whether there is a revival of the wholesalers' power, a reasonable point of view is that the wholesaling functions must be performed. Furthermore, small retailers and independent supermarkets have found it to their advantage to develop some sort of cooperative arrangement to do the job. There is reason to believe that this trend will continue as an effective competitive device for competing with the corporate chains.

## Pressure of consumers for lower food prices

There is a persistent pressure from consumers for low food prices. To compete in the food retail business, managers must keep operating costs to a minimum consistent with the services offered consumers. Since the volume of trade in a retail store has proved the most important variable in lowering unit costs, there is a tendency for the average size of store to increase. The multi-unit retail firm also developed on the assumption that economies of scale, particularly in buying and management, would warrant such an organization. The prevailing practice among the large retailorganizations is to deal directly with processors or other suppliers, thereby to reduce the number of title transfers and handling operations between the point of production and the retail market. Inasmuch as each title transfer or change in ownership usually involves a loading, storing, and reloading operation, the actual physical transfer of products between successive owners becomes a high cost factor. The Agricultural Marketing Service estimated transportation charges between the farm and retail store at 10 to 15 per cent of the farm-retail price spread. However, this percentage does not include intracity transportation costs such as local truck the far Mar

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The amo Exp tipl truck deliveries which frequently exceed the transportation cost between the farm and terminal market.

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Management has used various methods to control the unit costs of buying and selling. They can be classified into (1) improvements in handling practices, the purpose of which is to lower the inputs of labor and capital (facilities) per unit of output of product, (2) expansion of sales volume to utilize better the available labor and facilities, or (3) a combination of (1) and (2). Store modernization involving the introduction of labor saving devices has been proceeding rapidly since World War II, a change that was encouraged by higher labor rates and fringe benefits. On the selling side the widespread use of trading stamps as a promotional device in food retailing after 1953 brought some major realignments in consumer buying practices and some important effects on the distribution of trade among retailers.

#### Conclusions

This paper has merely skimmed the surface of some really important organizational changes in the food industry. It has emphasized the responsiveness of market organization and practices to changing requirements of the food market and reciprocal actions between the marketing system and consumers. In other words, the marketing system induces consumers to change their living and buying patterns by making different products and services available. Once the new product or service becomes available to consumers it permits them to choose among alternatives. These alternatives may be a choice of self-service, cash-and-carry food stores rather than the service-type store, or a choice of federally graded meat or dairy products instead of nationally-advertised, branded products. When consumers' choices completely alter former buying practices, the repercussions in the food industry can be dramatic and the effects on existing business operations may be severe.

The food industry is well aware of consumers' responsiveness to change. Therefore, members of the industry compete on the basis of certain types of conveniences for customers far more seriously than they do on the basis of prices. It was in such an environment as this that the processor attained economic power by identifying product quality with his proprietary, brand names, and subsequently supermarkets and retail chains gained consumer favor by offering a wide variety of products and services that seemed best adapted to a way of living.

The food industry is now undergoing some fundamental adjustments. The growth of the frozen-food industry is creating intense competition among processors for market outlets and shelf space in retail stores. Experiences in processing and selling a single frozen food item or multiple products forming a complete product-line have favored the latter

type of operation. As a result the industry is going through a series of mergers to develop economic-sized processing and distribution units. A further important factor is the need for new processing, cold storage plants, distribution centers in terminal markets, and adequate display space in retail stores, all of which require capital and market organization.

Finally, there is a desperate struggle underway between the nationally advertised-brand food manufacturers and retail chains and supermarkets that are pushing the sale of graded merchandise. Because of the shift in consumer preferences, for several food items, graded rather than branded, some of the major national food processors already have been forced to realign their operating practices in order to compete with small, local processors some of whom have certain cost advantages due to lower overhead and selling costs.

# DISCUSSION: "ADAPTING MARKET ORGANIZATION TO CHANGING REQUIREMENTS"

NORRIS T. PRITCHARD
Agricultural Marketing Service, USDA

DeLoach's modest claim that he has merely skimmed the surface of some important organizational changes in the food industry, although typical of him, understates the value of his penetrating review of the changes in the food industry resulting from changing market requirements and conditions.

Although it appears that DeLoach has not given adequate attention to the influence of new technology on market organization and practices, we can concede that the relative importance of technological developments as a causal factor is, in part, a matter of opinion. Among the major types of technological change to which greater importance could be attached are: (1) the developments in and widespread use of mechanical refrigeration both in marketing establishments and in households, and the development of other largely nonmechanical means of extending the shelf-life of foods; (2) the far-reaching changes in methods, speed, and quality of transportation services, especially highway transport; and (3) the amazing developments in mechanization and automation of food processing and distribution operations. Many processing functions that most people only a few years ago thought would remain as hand operations have now been mechanized. The impacts of these developments on the size and location of processing plants, on capital requirements of marketing firms, on costs, on procurement and selling practices, on prices and pricing methods, and even on farm production have been tremendous

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More emphasis might also have been placed on the growing power of the modern supermarket. The present struggle between retailers and other types of marketing firms is not, however, primarily a matter of costs and competition. In fact, the power conflict involving the use of national brands, federal grades, and retailer brands and other weapons becomes more understandable in the context of the theory of countervailing power than in terms of the competitive model.

Of special value are the indications DeLoach gives, directly and by implication, of needed marketing research. Economists generally are tragically ignorant of the nature of most of our markets for agricultural products. Too often we are unable to aid private firms and public agencies effectively in making decisions affecting the organization and performance of farm products markets. Furthermore, with a few exceptions, we are not directing many research resources into this important problem area.

Why economists have so long neglected the study of market organization and the performance of marketing systems is somewhat of a mystery. But some of the following thoughts on this question seem reasonably plausible and may suggest the nature of needed corrective action.

(1) Few of the essential data for these studies are readily available. Time-consuming interviews with owners and managers of marketing firms and service agencies are necessary. Economists, too, have the problem of allocating scarce resources among competing goals. But I am inclined to the view that some redirection of our research efforts might produce substantial benefits to the profession and its clientele.

(2) Most of the essential data on organization, practices, pricing methods, and market performance are essentially subjective in nature. They are not suitable for statistical analyses. For those economists with a strong fascination for analyses of variance, multiple regressions, and systems of simultaneous equations, an analysis based primarily on subjective information can have little merit. This is unfortunate. Economics, in the final analysis, is a study of human behavior and most of the important things we humans do simply cannot be measured by a system of numbers.

(3) Many economists have a strong bias against descriptive research. They seem to equate descriptive with unprofessional. No doubt, some published descriptions of markets deserve such condemnation. But description need not be superficial. Good description can penetrate below surface manifestations of market organization and practices and can provide clear and meaningful explanations of why a market and the firms that compose it function as they do. Furthermore, this is the only kind of research we can use on some of the most pressing problems in this general area.

(4) Our economic theory-the traditional competitive model-generally

ignores market organization under the oversimplification of direct producer-to-consumer selling. The firm, as it is presented in most theory texts, is a totally unreal, bloodless thing engaged in the simultaneous purchase of inputs and sale of outputs at constant rates. Although other errors of assumption and simplification are partially corrected by college courses in marketing, the fact remains that the applied researcher in this important area of market organization and performance would be aided materially by the development of some operationally meaningful theoretical structures.

Every modern science began with simple but nonsuperficial, empirical observations by intelligent and curious men. At present, study of market organization and performance seems to be in the first stage. Our need now is for many more nonsuperficial and nontrivial observations of markets by economists who are intensely curious about why markets are organized as they are, how and why decisions on prices and other matters are made, and why markets and marketing firms function as they do. We then may be able to give some meaningful answers to some complex problems, including those noted by DeLoach, urgently in need of our study and solution.

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## DEVELOPING BUYING POLICIES IN DECENTRALIZED ASSEMBLY MARKETS

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ROBERT L. CLODIUS University of Wisconsin

AGRICULTURAL marketing has been in pretty bad shape. Many of the early studies of markets and prices were directed at important problems and engaged issues which were significant for the welfare of farmers. Unfortunately the status of economic science was not sufficiently developed, nor were researchers sufficiently sophisticated in their science, and most of the research was descriptive. As specialization and exchange developed in the field of agricultural marketing, the prices work was captured by those persons who had become enraptured with regression analysis.

This parting of the ways was extremely unfortunate. The marketing specialist continued even more to concern himself with descriptive studies based on a commodity approach, the functional approach, the institutional approach, and so on. By sticking to these time-worn but "safe" approaches he was cutting himself off from the powerful ideas being developed in economic theory in which price determination and market behavior were determined within the structure of imperfectly competitive markets by the interaction of firms. Because these new theories were concerned with price making forces as well as market behavior, and because price research had been usurped by the prices specialist, perhaps the marketing specialist's ignorance and failure to use these tools is understandable.

However, the price specialist was not using them either. He had been carried away by the statistical techniques of the trade. His interest became one of mastering the statistical tools and then seeking the data, often highly aggregated, that would impart elegance to his results while minimizing the limitations imposed by the use of the formal mathematical-statistical models. This has led to high levels of employment, if not income, for price analysts, but it has led away from an understanding of price making forces at the farmers' level. As Breimyer has explicitly pointed out, with reference to the writings of others, the farmer receives his price at the first point of transfer of ownership of the product, not at any intermediate or final stage of distribution.<sup>1</sup>

It is with this kind of background that there seems to be a new interest in or awareness of the price making forces at the level of competition that concerns the individual farmer. To study the buying policies of firms who

<sup>&</sup>lt;sup>1</sup>Harold F. Breimyer, "On Price Determination and Aggregate Price Theory," *Journal of Farm Economics*, August, 1957, pp. 676-694.

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are engaged in procurement of supplies directly from farmers is  $a_0$  important way to learn more about the nonprice elements which are also part of the marketing transaction.

This paper will be concerned with research on the buying policies of such firms. It will examine the theoretical models which appear relevant, some of the types of investigations that have been conducted, and some of the problems and issues involved. It will not be concerned primarily with a statement of what buying policies are or have been in various markets,

### Theoretical Considerations

It may be assumed from the outset that the firms involved are buying in imperfectly competitive markets, for only imperfectly competitive firms can establish policies regarding their market behavior. These firms as buyers are grouped together according to their degree of interdependence—the extent to which the realized price or quantity purchased by one firm affects the quantity or price of another. Buyers also have similar structural attributes in regard to technology, markets, organization, or the like. Sellers in such a market are those farmers who view these firms as genuine alternative buyers. The products of the sellers are viewed by the buying firms as being close substitutes. Thus the basic conceptual design for defining the market is that elaborated by Papandreou and Wheeler and by Cochrane.<sup>2</sup>

There are several theoretical models which might be used in approaching research on buying policies. It is likely that several might be combined, or that a start with one might lead to another as the research developed. Perhaps the most obvious model is that of the theory of the firm with the necessary modifications on the market side to take care of the imperfections. This approach has the virtue of making inquiry into the productivity of factors and the costs of production.

It can be used to suggest two theoretical limits to the range of buying prices, as viewed by the buyer. One of these is the zero-profit-to-the-buyer limit where factor price is equal to average revenue product. The other is the buying price which would maximize profit to the firm. On the selling side, the cost side of the theory of the firm suggests that average product costs act as a limit on the price that the seller could be willing to accept and still break even. Thus theory which suggests insights into the range of buying prices can be very useful.

The theory of the firm is useful also because in imperfect markets it focuses attention directly on the active decision made by management

<sup>&</sup>lt;sup>2</sup> Andreas G. Papandreou, and John T. Wheeler, Competition and Its Regulation, Englewood Cliffs: Prentice-Hall, Inc., 1954; and Willard W. Cochrane, "The Market as a Unit of Inquiry in Agricultural Economics Research," Journal of Farm Economics, February, 1957, pp. 21-39.

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about what prices to pay, what services to offer, what attempts should be made to manipulate other market factors to enhance the firm's profit account and how to meet the competition of rivals. Thus the model forces the researcher to a consideration of the managerial decisions that create the market policies of the firm.<sup>3</sup> Probing these decisions leads to some of the features of structure which are important to the firm's behavior.

Another approach closely related to the first is often called market structure analysis. It directs attention to the explicit price and nonprice performance in a market and seeks to explain the variation found in terms of certain structural attributes of the market. What these "structural attributes" are is suggested by the model but others must be found in the course of the research itself. They make up the fundamental variables whose magnitudes are taken into account by management in deciding on market policy. Among the obvious ones are the number of firms in an industry, the type of product produced, and conditions of entry. It has been argued that "conditions of entry" might be eliminated because number of firms includes results of entry. Analytical reflection suggests that explicit recognition of conditions of entry is necessary to reflect the potential increase of firms as a factor influencing market performance and not just the actual number of firms at a given time.

This last point serves to introduce the concept of the limit price as applied to the buying policies of firms. It is that price for factors below which the monopsonist or oligopsonist will not exert his market power for fear of inducing entry of new firms.<sup>5</sup> Other factors serving to set a limit on buying price would be fear of anti-trust prosecution, fear of invoking wage demands and strikes by organized labor, fear of invoking the creation of countervailing power through the organization of sellers, and the like.

As one pursues all the implications of the market structure approach, he may be brought to a consideration of the nature of the cost relationships internal to the firm. If the short-run average cost curve declines significantly with volume handled, the buying policy of the firm may be influenced accordingly. The incremental value of an additional unit of input to the firm may be high because of its effect in lowering unit cost on all units of product. In this case pursuit of structure has led to the point where a theory of the firm approach might logically begin.

A third approach could be that through models of vertical integration.

<sup>&</sup>lt;sup>3</sup>This "managerial economics" approach has some status in its own name, but I continue to categorize it as a "jazzed up" elaboration of the theory of the firm.

Willard W. Cochrane, op. cit. fn. 17, p. 32.

\*Joe S. Bain, "A Note on Pricing in Monopoly and Oligopoly," American Ecoomic Review, March, 1949. For further discussion entry see Joe S. Bain, "Condi-

nomic Review, March, 1949. For further discussion entry see Joe S. Bain, "Conditions of Entry and the Emergence of Monopoly" in Competition and Monopoly and Their Regulation, Edward H. Chamberlin (editor), London: Macmillan and Co., 1954.

Vertical integration is here defined as the extension of ownership or control over successive steps of production and marketing by a single or joint unit of management. The relevance of the concept for considering buying policies in decentralized assembly markets is readily apparent.

Vertical integration theory suggests to the researcher that he investigate both the form of integration and the reasons behind it. The more subtle forms of integration are those involving nonownership. These include such things as contractual agreements, the granting of services or concessions

which create an obligation, tie-in advertising, and the like.

Investigation of the reasons for integration reveals factors on both the market and the cost side of the firms involved, and acting together they affect the firm's profit account. On the buying side, the following factors may be identified-uncertainty regarding availability of supplies, widely fluctuating prices, reduction of competitive pressure from rivals, control over factor quality, and circumstances where "make is cheaper than buy." While these market oriented reasons may have important repercussions on costs, it is also useful to specify factors which have their origin in the production function and the cost functions. Among these are technological economies from integration resulting in more efficient production and the elimination of selling costs.

As this approach is pursued, the researcher must come to many of the same areas which other approaches emphasize. Only by knowing the structure of the markets involved can all the implications of vertical integration be analyzed. These refer to the stability, market power, and income redistribution effects which may or may not be associated with a particular integration. The incidence of these effects is determined by the structure of the buying and selling markets originally and after the change. Inquiring into the reasons for vertical integration is also another way of analyzing managerial decisions and brings this approach into the investi-

gation.

Vertical integration theory suggests other leads for research. These include considerations of the firm's network of communication and knowledge which might be improved, considerations of safety or security of assets, political activity to secure particular legislation, and access to capi-

These remarks serve to suggest that there are many useful theoretical approaches to the analysis of the buying policies of firms in decentralized assembly markets. Which approach is chosen will vary with the way in which the researcher conceives the problem to be analyzed and in part with the researcher's own predilection. Two or more approaches may be combined frequently with good purpose. It seems likely that regardless of the model or models the researcher can use them to direct him to the strategic i and re of the

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## Recent Research Using These Approaches

It is not possible to comment on all of the research making use of these approaches. The examples are chosen not as the best nor the worst but as illustrative of the use of the nonpure theoretical model approach to policies of firms buying agricultural products from farmers in decentralized markets.

There are other types of marketing research in this area. They are not included here and should be strongly criticized because no analytical use of theoretical models is employed. Much of the research on grower-canner contracts would bear this criticism. Most of it still seems to be in the old-fashioned, descriptive tradition of marketing research.

One example of the use of a theory of the firm approach, modified for imperfect competition and managerial decision orientation, is a study of "Procurement Policies and Practices of a Selected Group of Dairy Processing Firms." To provide a basis for inquiry into the managerial decisions of nine firms of the group, a market structure approach was used initially on the 49 firms making up this market. The structural elements considered were number of firms, type of product, type of ownership, size of firms, financial status, and seasonal utilization of plant capacity. In general higher prices paid farmers for milk were associated with more firms competing, cheese as the product, independent proprietorship, small size, very poor financial rating, and a good seasonal utilization.

However, these structural attributes cannot explain the total performance of this market which was characterized on the whole by nonaggressive "average" pricing policies and by use of implicit and nonprice policies. What these policies and related practices were and the reasons behind them were revealed by inquiring into management's decisions about procurement. Although the specific content related to the milk procurement market, any student of oligopoly and monopolistic competition would recognize and understand what was going on.

One feature deserves special comment. It has to do with the level of information on both sides of the market. Management possesses market information, and in some degree tries to keep farmers uninformed and confused. They are successful. Farmers don't have accurate market infor-

<sup>&</sup>lt;sup>6</sup> R. L. Clodius, D. F. Fienup and R. L. Kristjanson, Part I, Some Aspects of Market Structure, Competitive Behavior and Market Results, Wisconsin Agricultural Experiment Station Research Bulletin 193, January, 1956, and Part II, Managerial Aspects of Price and Nonprice Competitive Behavior Among Nine Dairy Processing Firms, Wisconsin Agricultural Experiment Station Research Bulletin 199, February, 1957.

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mation. This factor seems so important in explaining market performance that perhaps it should have the status of a structural element.

At this point old-timers may exercise the privileges of their age and the federal Constitution and sneer because research and effort has been going into improving market information for years. They feel virtue lies with them because they were removing "imperfections" to achieve perfection both in theory and in practice, and after all, no one can improve on the "perfect" market. Such an article of faith is touching but unscientific, A scientific statement would involve the hypothesis that the level of information is related to the performance of the market. Having determined both the level of information and the results in different segments of a market and by experimentally altering the level of information, researchers may be able to determine the consequences of the action and the relationship between information and performance. After this is done, the policy of altering market information may be considered in a much more meaningful manner. It is conceivable that providing farmers with more market information is undesirable in that it may shift rivalry from a nonprice to a price basis and produce either complete collusive pricing or chaotic market conditions not conducive to the best interests of buyers and sellers.

Another example is the study, "The Nature of Competition Among Apple Processors in the Appalachian Area." It begins as a market structure analysis and considers the effect of the power relationship which is made up of number of firms and type of product, the ease of entry of new firms, and the presence of a cooperative. Each of these was found to be related to market performance.

As he proceeded, the author found it desirable to inquire into the framework of managerial decisions. He considered such things as the time interval used in decision making, the nature of costs as related to market decisions, opportunity for implicit price manipulation, and the ability of non-cooperative firms to establish pricing practices that were similar to cooperative firms.

Certain conditions suggested a lack of genuine competition. There were few firms buying in the market, and two bought about one-half of the total volume. Price leadership was exercised by the Big Two and other buyers tended to follow. Other factors suggested active rivalry and effective competition. They included a cooperative which returned all receipts over cost on a patronage basis, opportunity to use implicit price deals to shade the price announced by the price leader, no cost advantages associa-

<sup>&</sup>lt;sup>7</sup> Claron Burnett, "Farmer Evaluation of Procurement Policies and Practices of a Selected Group of Dairy Processing Firms," unpublished manuscript proposed as a Ph.D. thesis, Oklahoma State University, 1958.

<sup>\*</sup> Homer C. Evans, West Virginia Agricultural Experiment Station Bulletin 405, June, 1957.

ted with large scale, and relative ease of entry of new firms. In summary, the author concluded that competitive pressure was strong enough to dissipate any excess profits.

In my opinion, the outstanding element of structure in this market was the cooperative. On the all important matter of policy, it illustrates what a cooperative can do in the way of maintaining the workability of competi-

tion in decentralized assembly markets.

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The third example is "The California Canning Tomato Industry—A Study in Grower-Processor Integration." It is a combined vertical integration and market structure approach. Vertical integration is getting the play these days because it caught the public and private fancy, whereas monopsonistic competition, oligopsony and monopsony are doomed because of the decreasing numbers of people with an interest in the classical studies, particularly Greek. Persons like myself, who started out with this classical approach and now learn to their surprise and delight that they have been speaking vertical integration for 10 or more years without knowing it, are participating emotionally with Moliere who said, "For more than 40 years I have been speaking prose without knowing it."

In their study the authors examined grower-processor integration in terms of the technical and market reasons underlying it, the nature and extent of the integration, and its legal basis. The nature of raw market supply was found to be critical to both grower and processor income positions. Quantity, location, variety and quality, and timing of deliveries were variables in which control was desirable through vertical integration. The primary method for achieving this was forward buying although some small amount of integration involved ownership. Forward buying acquires

legal status in the form of the marketing contract.

As structural elements, the authors considered size and location of plants, multiple product processing, concentration in procurement patterns, and the number and organization of buyers. On the supply side, they considered number of growers and size of enterprise, location, sea-

sonality of production, and organization of sellers.

Market performance was characterized by "barometric" pricing where other firms followed the price announced by the "barometer" firm. This dimension of competition was found to be modified by implicit and non-price factors such as waiver of picking box rent, hauling allowances, payment tolerances, extension of credit, "tie-in" arrangements with other crops, technical assistance, and others.

After analyzing the consequences of the integrated relationship found in terms of the structure of this market, the authors concluded that verti-

<sup>&</sup>lt;sup>9</sup>Norman R. Collins, Willard F. Mueller, and Eleanor Birch. Forthcoming California Experimental Station Bulletin.

cal integration per se had not brought about an income transfer between growers and producers, nor had it contributed to production stability. Genuine rivalry among firms and other factors resulted in prices close to competitive levels, while supplies varied more than 25 per cent from one year to the next on the average from 1945 to 1956. Finally, the forces of disintegration may be as important as those tending to promote vertical integration in decentralized agricultural markets.

#### Some Problems and Issues

A continuing problem in the field of industrial organization and imperfect competition is the development of more adequate theory. Adequacy is defined in terms of research guides, statements of variables and relationships that can be tested, specification of the strategic factors, and appropriateness for welfare and public policy recommendations. Present theory can be useful in guiding research as attested by the research which has been done. But quantitative measurement and statistical testing is difficult within the received models.

Various attempts have been made to measure the degree of monopoly power. Some have empirical content, but others are so defined as to preclude even qualitative measurement. Most of these markets involve a sociology of competition in addition to the pure economic relationships. Since index numbers have been used successfully to combine socioeconomic variables, there may be an opportunity in the future to try to establish an index of competition. If such an index could be created, it would permit measurement of market performance, comparisons through time, and inter-market comparisons.

Additional theoretical work is needed on power relationships in economics. Economic power is related to market structure, and it seems clear that in pure-pure markets there is no power for either, while a firm which is both monopsonist and monopolist facing pure sellers and buyers has about the maximum amount for itself. For all market structures in between, there is something less than clear-cut power relationships. In some cases, the power inherent on one side of the market may be countervailed by firms on the opposite side. In others the power may be dissipated among various rivals as well as across the market.

Additional theory is needed also on the welfare and public policy aspects of competition relating to buying policies. It would be rebundant here to repeat in detail that perfect competition theory presents an intellectual snare and delusion for welfare and public policy. What is left are some ideas relating to workable competition, some ideas about countervailing power, and not much else.

Here, too, lies one of the important present day issues. What is to be taken as evidence of increasing or lessening competition? There are the

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advocates of using structural determinants. As number of firms increases, product differentiation decreases, and entry eases, competition becomes more effective and more workable and vice versa. Advocates of the use of performance standards argue structure is not as important as market results in such terms as the relationship between cost and price, relation of plant scale to the optimum, progressiveness of the firm in introducing efficiencies, in product innovation and development and the like.10

This issue is not one that can be settled by economists alone because attorneys in the anti-trust and trade regulation fields and ultimately the courts are struggling with it.11 There is some feeling that workable competition defined through performance standards means unworkable law.

Also on the theory side, more work needs to be done on the role of the cooperative in market performance. Viewing the cooperative either as a vertical extension of the farm firm or as another firm in a market does not seem to be completely satisfactory in analyzing welfare and policy questions of competition in buyers' markets where cooperatives are found. Some research suggests that in certain markets the cooperatives are just going along for the ride, following "live-and-let-live" policies, and contributing nothing more than a non-cooperative firm in terms of making competition more effective. 12 On the other hand, the cooperative seemed to be the strategic element in making competition effective in the apples for processing market even though the cooperative was not the price leader.13 The "quasi-bargaining" cooperative in the tomato market was also found to contribute to the effectiveness of competition.14

This points up the necessity for additional research effort in the field. Literally scores of markets must be investigated if reliable generalizations are to be made about competition with farmers as sellers. Judgments must be made about the activities and effectiveness of cooperatives in these markets. Whether competition will serve farmers effectively in the future may depend in large part on cooperatives either as competitors or as countervailing elements.

Research should also be extended by using the industrial organization orientation into markets lying between the decentralized and the retail.

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<sup>&</sup>lt;sup>10</sup> Among structuralists might be included Corwin Edwards, Maintaining Competition, New York: McGraw-Hill Book Co., 1949; and Edwards, Mamualing Competition, New York: McGraw-Hill Book Co., 1949; and Edward Mason, Economic Concentration and the Monopoly Problem, Cambridge: Harvard University Press, 1957. An advocate of performance standards is Jesse Markham, "An Alternative Approach to Workable Competition," American Economic Review, June, 1950.

1 For just one illustration see John C. Stedman, "A New Look at Antitrust: The Report of the Attorney Converging Competition." In Journal of Public Law Values 4

Report of the Attorney General's Committee," Journal of Public Law, Volume 4, Number 2, 1956. Mason op. cit. also has several good chapters in Part IV, Antitrust

<sup>&</sup>lt;sup>12</sup> Clodius, et al. op. cit.

<sup>13</sup> Evans, op. cit.

<sup>&</sup>quot;Collins, et al. op. cit.

This area has been commended to agricultural economists before and bears repeating.

As research results are accumulated, the basis is laid for the modification of existing theory or the creation of new theory. Development and progress in any field seems to be a cumulative process, and the interrelation between theory and research makes them mutually supporting. Here is the opportunity again to bring the marketing and prices fields together.

One of the limiting factors for advancing theory and research is the shortage of people with appropriate training. Judging from the stereotype of agricultural marketing and research as judged from textbooks and bulletins in the field, one gets the impression that very few academic institutions are equipping their marketing students to do effective work in market structure. More intensive instruction in the functional, commodity, perfectly competitive, or efficiency approaches is not going to further research in market performance in the real world.

Some of us are convinced that this field for agricultural economists is intellectually stimulating, productive of useful research, and wide open in opportunity. The structural attributes of this market are few individuals, producing differentiated products which are durable and highly substitutable, and, most significant of all, the only obstacle to entry is adequate training. As knowledge of great intellectual returns to be earned becomes widespread, it can be hoped that more individuals will enter the field.

# DISCUSSION: DEVELOPING BUYING POLICIES IN DECENTRALIZED ASSEMBLY MARKETS

KENNETH D. NADEN
National Association of Food Chains

Clodius has, is a most comprehensive way, surveyed the development, and outlined the progress and the problems facing research in market structure and organization. I find little in this paper with which to make fundamental disagreement so will confine my remarks to differences in emphasis and approach which might be made.

Although he stated that his paper was concerned with "research on the buying policies of firms", he said, indirectly, that this means research on market performance in the real world. I wish that he had placed the emphasis clearly on market performance early in the paper since, in my opinion, it is more valid and more realistic to look at market performance than to look at the number of firms, type of firms and complexity of arrangement surrounding buying and selling. The relationship between elements of structure and market performance is not at all uniform or dependable.

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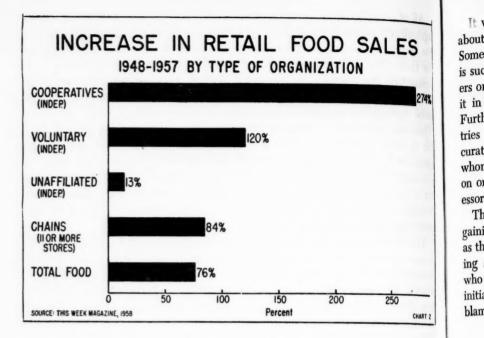
All of us in the food industry and in ancillary groups (and this includes agricultural economists at the experiment stations) recognize that one of the burning issues of the past decade has been the rise in marketing costs for food. The recurring attention given this subject by congressional investigating committees, by the press, and at farm organization meetings, testifies that it is a key economic and political question. Marketing costs or price spread are simplified into costs and margins for specific products. There is a great deal of information on the constituents of the price spread for specific commodities, but this information still does not answer the question for farmers and legislators—are marketing margins too large or too small? This must be answered in terms of dollars and cents as the price for a service (wholesaling, processing, retailing, storage, etc.) and no price is high or low except by comparison with some standard. What is the appropriate standard against which to measure these prices?

The best clue to whether marketing margins are too high or too small is answered by "What is the performance of the markets in which these commodities are handled?" Economists will find, I believe, a closer correlation between performance and the vitality and vigor of the competition existing than between the performance and number of firms, type of products, buying policies, etc.

I would suggest that although economic theory has been exceedingly helpful to researchers in this field by setting up models which they might use, it may also have been harmful by keeping our eye on the trappings of competition rather than on the effectiveness of a market to do the jobs which are put before it.

All of us know, for instance, that there have been important changes in the size of firms and in the organization and structure of certain markets and that these changes have not been uniformly associated with an improvement or a decline in the performance of the functions set before them. For instance, changes in size and organization of firms in the fresh produce trade has not improved the efficiency of many wholesale produce terminal markets in our principal cities.

An example of a change in the organization and structure of the retail food industry has been occurring in the past decade, and has had a favorable effect on marketing margins at retail. This is growth in the organization of the cooperative and voluntary groups of independent merchants. The following chart shows that in the past 10 years the growth in total sales of the small chains and of the cooperative and voluntary groups of independents has far exceeded the growth in total food sales or growth of larger chains. It also shows that the unaffiliated independents had practically no increase in sales in the past decade. This change in organization of affiliated independents has been accompanied by many changes in mechanization, in size of store, and in efficiency of operation which



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Another observation in this field may be pertinent; in the past decade there has been an increase in food sales in a smaller number of supermarkets-a form of concentration. In 1957, for instance, 10 per cent of the total food stores in the country handled 67 per cent of the total food sales. Both number of stores and total sales were divided about evenly between chain and independent. It is common knowledge that this rise in the number and importance of supermarkets as food outlets has been accompanied by an improvement in the competitive structure at this level and in improvement in efficiency of operation.

A weakness in our theory of the firm is the complications that arise from multiple products and from vertical integration in firm operation. These have not been fully explored. Theory suggests that a firm knows precisely what its costs of operation are. In the retail food store, there is only an approximation being made to cost of handling and the principal requirement is that the firm attempt to earn enough through its gross margin on the entire store offerings to cover all costs.

Clodius made a special comment about the level of information on both sides of the market as affecting market performance. This factor is so important in explaining market performance that it should be considered the most important element involved.

It would have been better if Clodius had not been quite so dogmatic about the statement "Farmers don't have accurate market information." Some farmers in nearly every market do not. On the other hand, there is such a vast amount of market information readily available that farmers or any marketing agencies who wish to avail themselves of it and use it in their marketing process can do so with a minimum of trouble. Furthermore, instead of saying that management has information and tries to keep farmers uninformed and confused, it would be more accurate to say that any buyer or any seller attempts to keep the other (with whom he has business) uninformed and confused. The weight is not all on one side of the bargaining process, no matter whether farmers, processors, retailers or labor unions are involved.

The level and amount of information in the hands of many farmers' bargaining and cooperative processing and selling organizations is as good as that of many marketing firms in the wholesaling, processing and retailing sectors. They have information and are using it wisely. Farmers who do not have this kind of information because they have not taken the initiative to organize and to seek and use such information should not blame other segments of the industry.

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# IMPACT OF TECHNOLOGY ON PRICES AND INCOMES IN AGRICULTURE

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Chairman: Nathan M. Koffsky, Agricultural Marketing Service, USDA

### PRODUCTIVITY TRENDS IN AGRICULTURE AND INDUSTRY

JOHN W. KENDRICK George Washington University

PRODUCTIVITY estimates based on the relationship of output to all associated inputs, in real terms, are our best measures of changes in productive efficiency. Partial productivity measures are useful in showing savings of particular inputs achieved over time as a result of factor substitutions as well as changing technological efficiency. But to indicate the net savings of inputs as a whole, and thus the increases in efficiency as such, output must be related to all corresponding inputs.

This is the concept underlying the productivity estimates for the farm and nonfarm sectors of the private domestic economy presented in this paper for selected years of the period 1889-1957.¹ More specifically, the estimates are index numbers of ratios of real gross product (i.e., output net of intermediate product inputs but gross of capital consumption) to a weighted aggregate of the corresponding inputs which consist of the basic factors of production, labor and capital, including land. Before proceeding to the productivity comparisons, we shall explain the constituent concepts and measures of output and input, and note their behavior as individual series.

### Output

The national product, as an unduplicated total, can be obtained as the sum of purchases of final goods and services, by type, or as the value added by each industry of the economy to final product. Value added, or industrial product, can be estimated as the compensation plus nonfactor charges against product (primarily indirect business taxes) of the factors employed in an industry, or as the value of production less expenses for intermediate products purchased from other industries. The latter estimating approach is necessary to convert industry product into constant prices, by deflating the values of gross output and of intermediate purchases, before striking the difference. The advantage of using real industry product estimates for output and productivity comparisons is that they are consistent and comparable with each other and with the national estimates.

<sup>&</sup>lt;sup>1</sup> For further discussion of concept and an analysis of productivity movements in 33 industry groups and the private economy as a whole, 1899-1953, see John W. Kendrick, *Productivity Trends: Capital and Labor*, Occasional Paper Number 53, National Bureau of Economic Research, 1956.

Estimates of the United States farm gross product in current and constant dollars were first published by the U.S. Department of Commerce in 1951.<sup>2</sup> The underlying figures came largely from the Department of Agriculture, benchmarked on the quinquennial censuses, interpolated and extrapolated by data from the Department's sample surveys.

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The gross output portion of the measure comprises the deflated value of cash receipts from farm marketings and Commodity Credit Corporation loans, net changes in farm inventories, farm products consumed directly in farm households, and gross rental value of farm homes. Although somewhat different in concept, the trend of this measure is virtually the same as the Department's index of farm output. It also shows much the same trend 1910-1937 as the Strauss and Bean index of farm production, which was used to extrapolate our measure back of 1910.3

The intermediate products consist of commercial seed, feed, fertilizers, motor fuel, irrigation, veterinary services, and other items charged to current expense. Some of the items represent market purchases by farmers from each other, deduction of which from the value of output eliminates duplication arising within the farm sector. Gross output is already net of intermediate products produced and used on farms without passing through organized markets. The bulk of intermediate products, however, is purchased from the nonfarm sector. Their deduction yields a net output figure.<sup>4</sup>

So defined, net farm output is equivalent to the national product originating in farming, as estimated by the Department of Commerce with one qualification. The Department deducts gross rents paid to nonfarm landlords, as well as intermediate products, in order to arrive at the farm gross national product. By this definition, farm product is confined to the net output (gross only of capital consumption allowances) produced by

<sup>&</sup>lt;sup>3</sup> See John W. Kendrick and Carl E. Jones, "Gross National Farm Product in Current and Constant Dollars, 1910-50," Survey of Current Business, September, 1951, pp. 13-19. The estimates were later revised and extended by Atkinson and Jones in the August, 1954, Survey. The author is indebted to Atkinson for the most recent preliminary estimates of the components required to extend to 1957 the series given in Table 1.

<sup>&</sup>lt;sup>8</sup> Frederick Strauss and Louis H. Bean, Gross Farm Income and Indices of Farm Production and Prices in the United States, 1869-1937. Technical Bulletin Number 703 (U. S. Department of Agriculture, 1940). The rental component, however, was extrapolated by Alvin S. Tostlebe's estimates of the real stock of farm buildings, Capital in Agriculture: Its Formation and Financing since 1870 (Princeton University Press for the National Bureau of Economic Research, 1957), Appendix H. See Tostlebe also for a comparison of a number of the leading output series with regard to concept and movement.

<sup>&</sup>lt;sup>4</sup>The ratio of intermediate products in constant dollars to real gross output was extrapolated back of 1910 by estimates of Marvin W. Towne and Wayne D. Rasmussen, "Farm Gross Product and Gross Investment during the 19th Century," paper prepared for the Conference in Research in Income and Wealth, September 4-5, 1957 (National Bureau of Economic Research, mimeographed).

factors located within the sector. In our measure, however, we include the portion of farm output that represents the return to capital used in farming irrespective of the location of the owner. Our estimates of capital, including land, also comprise total real capital employed in farming. A breakdown of capital by ownership would tend to be arbitrary and possibly distort the productivity relationship. The net output trend practically parallels that of the real national product, since real gross rents paid to nonfarm landlords have increased proprotionately with real farm product between 1910 and 1953.

As shown in Table 1, the ratio of intermediate products consumed to gross farm output in real terms has increased from about 13 per cent in 1889 to 36 per cent in 1957. This reflects two main forces. First, some of the activities formerly performed on farms have been shifted to nonfarm industries. For example, when animals were the chief source of non-human power, their feed was grown on farms; now that tractors and trucks

TABLE 1. GROSS AND NET FARM OUTPUT (millions of 1929 dollars)

	Gross farm output*	Intermediate products consumed <sup>b</sup>	Net farm output <sup>c</sup>	Ratio of net to gross (percent)	
1869 3,950		440	3,510	88.9	
1879	6,180	730	5,450	88.2	
1889	7,820	1,000	6,820	87.2	
1899	9,920	1,360	8,560	86.3	
(1909)	10,770	1,620	9,150d		
1910	11,080	1,660	9,420	85.0	
1919	11,930	2,250	9,680	81.1	
1929	13,670	2,940	10,730	78.5	
1937	13,990	3,060	10,930	78.1	
1948	18,880	6,100	12,780	67.7	
1953	20,100	7,040	13,060	65.0	
1957p	21,920	7,980	13,940	63.3	

<sup>a</sup> Equals "total value of farm output," as given in tue August 1954 Survey of Current Business, Table 1, line 1, p. 22, deflated and extrapolated to 1869 as described in the text and below

b Ibid., line 7 minus line 9 to 1910; 1869–1909 based on extrapolation of the ratios of intermediate products to gross farm output by ratios based on the constant dollar estimates 1860–1900 by Towne and Rasmussen, op. cit., interpolated linearly and extrapolated to 1909 by the 1890–1900 rate of change in the ratio.

<sup>o</sup> This is equivalent to the Commerce Department's "farm gross national product" (op. cit., line 10) inclusive of rents paid to nonfarm landlords (op. cit., line 8), but with deflation procedures altered as described below.

d Estimated by applying 1910 ratio of net to gross to the 1909 estimate of real gross farm

Note on weighting: For the four components of gross output, and intermediate products as a whole, Commerce deflators on a 1939 base converted to a 1929 base were used to 1940, linked to deflators on a 1947–49 base for the period 1940–1953, and to deflators on a 1954 base for the subsequent years. Then the components were reweighted by average prices in the terminal years of each subperiod acc rding to the Marshall-Edgeworth formula, and linked to the 1929 values before aggregation of the output components, and subtraction of the intermediate product total.

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have largely supplanted work stock, farmers must purchase petroleum products from the nonfarm sector. Secondly, relative purchases of intermediate products have risen because efficiency and net income could be increased thereby. Chemical fertilizers and insecticides, commercial feeds with added nutrients, and the like, increase output enough to pay for their increasing use—which was undoubtedly accelerated by the favorable relative price trend as well as improvements in quality of the intermediate inputs.

As a result of the large relative increase in intermediate inputs, net farm output doubled between 1889 and 1957, compared with practically a tripling of gross output. At average annual rates, gross output rose by 1.5 per cent, compared with 1.1 per cent for net output. This difference carries over into the productivity ratios, of course, when the same input measures are involved. The divergence between gross and net output changes has differed from one subperiod to another. It first became substantial during the World War I years; was at a maximum during the decade including the World War II, and has been above the long-term rate in the past decade.

For reasons well known to members of the AFEA, even gross farm output has grown at a much smaller rate than real product in the private domestic nonfarm sector, which averaged almost 4 per cent a year advance between 1889 and 1957. The nonfarm estimates are based on the Commerce Department's estimates of gross private product, deflated by types of final expenditures, extended to the year before 1929 by the latest estimates by Simon Kuznets with the reconciliation items provided by the author. The nonfarm sector figures are a residual obtained by subtracting from gross private national product first the item of real net factor income from abroad to put the figures on a domestic basis, and then the real gross farm product.

## Inputs

If inputs are to be related to outputs for the purpose of productivity comparisons, they must be measured without the effect of efficiency changes. To accomplish this, we estimate the number of hours in which labor and capital resource stocks of various types (as indicated by differing unit compensations) are employed or available for use and represent a charge to the producer. As is the case with the average unit cost concept of value theory, there is a duality with regard to factor cost in a free enterprise economy. Labor is a direct charge only when employed, while capital is a continuing cost to the property owner, either explicitly or implicitly depending on type of financing. From a social cost view, the degree of utilization of the labor force is also an aspect of the efficiency of

the economy, but the measures presented in this paper reflect a private

enterprise viewpoint.

By weighting the available service-time of the factors by their base period compensation, we obtain a measure of what the resources would have produced in a current period had technological and other conditions of efficiency remained the same as in the base period. By dividing this measure into the *actual* output in successive periods, we obtain measures of the changes in the efficiency with which the factors are utilized in the

processes of production, i.e., of their productivity.

Labor input is measured in terms of manhours worked in the various industries, weighted by base-period average hourly labor compensation. All kinds of workers are included, proprietors and unpaid family workers as well as employees, and nonproduction as well as production workers. For the private nonfarm domestic industries, the Commerce Department's estimates of employment were used, carried back of 1929 primarily by industry and population census data. The employment figures are multiplied by available estimates of average hours worked. The farm manhours series are as estimated by the Agricultural Research Service (ARS) of the Department of Agriculture, 1910-1950. The latest benchmark for this series was 1950 and since there is some indication of upward bias thereafter, we spliced in 1950 to the Census Bureau's estimates of agricultural employment and hours based on the current population surveys. Comparison of the Agriculture Department's estimates of manhours and employment suggests relatively little decline in the average hours worked per year on farms-due in part, no doubt, to shifts in relative importance of the various types of farming. For years prior to 1910, we assume there was no significant change in average hours and extrapolate the farm manhous series by the farm employment estimates of ARS derived from census

Over the period under review, farm manhours declined at an average rate of 0.8 per cent a year, compared with an increase of 1.6 per cent a year in nonfarm manhours. The rate of decline in farm manhours appears to have accelerated since the drop began around 1918. Farm employment, until recent years, declined only slightly less than farm manhours—although we must recognize that our knowledge of average hours worked per year on farms is rough at best. Nonfarm employment, on the other hand, increased at an average annual rate of 0.6 per cent more than nonfarm manhours due to the substantial decline in the average work week in nonfarm industries.

When manhours in each of about 40 nonfarm industries are weighted by base period average hourly compensation, the resulting "labor input" rises about 0.2 per cent a year more than unweighted manhours due to the relative shift of workers from lower to higher-paying industries. The

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difference between rates of change in weighted and unweighted manhours in the private domestic economy as a whole is 0.4 per cent, the additional 0.2 per cent reflecting the effects of the farm to nonfarm employment shift. Within the farm sector, however, data are not at hand to make possible an internal weighting of manhours; but here, too, there has probably been a relative shift towards the more remunerative types of farming.

The final piece we need to complete the total factor productivity ratio is real capital services, or input. In effect, we measure available capital years by estimating average annual real capital stocks (net of depreciation). This concept is parallel with the manhour concept, since capital hours could be obtained by multiplying annual stocks by the constant factor of 8,760, assuming full potential availability throughout the year. But, of course this index would parallel the movement of the average real stock index. Even if we tried to measure actual hours that capital is utilized, there is no evidence that rates of utilization have exhibited a trend in either direction, and it is probably not unrealistic to assume that capital hours actually used productively have moved parallel with real capital stocks in the economy as a whole between years of high-level activity.

Capital stocks include plant and equipment, land, and inventories. Plant and equipment are taken net of depreciation. Studies by Terborgh and others strongly suggest that the net income from capital goods declines gradually as the goods age, due to rising maintenance costs and creeping obsolescence over groups of items. Depreciated stock roughly reflects this phenomenon, and its movement is influenced by changing age-composition. In effect, we measure each type of capital by age classes, since each age class earns a different relative compensation. In practice, we weight the index numbers of the real capital stocks in each industry by relative capital compensation (interest plus profit) in the base period—which is equivalent to weighting the capital stocks in constant dollars by base period rates of return. Capital and labor inputs in constant dollars could be added; but, in practice, we weight the index numbers of each by relative compensations to obtain total factor input.

The farm capital stock estimates are based largely on those of Alvin Tostlebe. He weights land acreage in various regions and types of use by base period unit values; inventory units by base period values; and deflates the values of plant and equipment as reported in the censuses by price indexes. The nonfarm capital estimates are based largely on those by Raymond Goldsmith.<sup>5</sup> Instead of deflating book values, Goldsmith cumulates real net capital formation to obtain his "perpetual inventory" of reproducible capital.

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<sup>&</sup>lt;sup>8</sup> Raymond W. Goldsmith, A Study of Saving in the United States, Vol. III, Princeton: Princeton University Press, 1956.

In the farm economy, capital inputs have increased at an average annual rate of almost 1 per cent a year, compared with about 3 per cent in the nonfarm economy. In relation to labor input, the rate of increase has been higher in the farm economy—1.7 per cent a year compared with 1.3 per cent. If we assume that relative unit factor compensations indicate marginal rates of substitution between the factors, then our measure of total factor input divided by labor input yields a measure of rates of substitution of capital for labor—in farming it has proceeded at twice the rate as in the nonfarm economy, 0.6 per cent a year on average over the period compared with 0.3 per cent. This means, of course, that the difference in movement of total factor input between the two sectors has been a bit less than the difference in movement of labor input alone. Total farm factor inputs showed a slight decline averaging 0.2 per cent a year over the period, compared with a 2.1 per cent average increase of nonfarm input.

### Productivity Movements

Now we are in a position to look at productivity movements in the farm and nonfarm sectors, summarized in Table 2. Taking the 68-year period as a whole, total factor productivity in farming increased at an average annual rate of 1.3 per cent compared with 1.8 per cent in the private domestic nonfarm economy. If gross farm output is related to total factor input, the average annual rate of advance of 1.7 per cent is almost as high as the nonfarm rate—but to be conceptually precise, if gross output is used in the numerator, intermediate product inputs should be included with fac-

Table 2. Output, Total Factor Productivity and Partial Productivity Ratios Farm and Nonfarm Sectors of the Private Domestic Economy Average Annual Rates of Changes, 1899–1957 and Subperiods

(percentages)										
	1889- 1957	1889- 1899	1899- 1909	1909- 1919	1919- 1929	1929- 1937	1937- 1948	1948- 1957		
Real gross product										
Farm	1.1	2.3	0.7	0.6	1.0	0.3	1.4	1.0		
Nonfarm	3.9	5.4	5.1	3.4	4.1	0.1	4.8	3.8		
Total factor productivity										
Farm	1.3	1.0	-0.2	-0.3	1.2	0.8	2.7	3.7		
Nonfarm	1.8	1.7	1.6	1.3	2.0	1.7	2.1	2.0		
Output per unit of labor input										
Farm	1.8	1.3	0	0	1.2	0.8	3.8	5.7		
Nonfarm	2.1	2.4	1.8	1.8	2.4	1.9	1.9	2.6		
Output per unit of capital input										
Farm	0.2	0.5	-0.7	-0.7	1.2	0.8	0.4	-0.2		
Nonfarm	0.8	-0.2	0.8	0.2	1.1	1.0	2.9	-0.3		

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tor inputs in the denominator. The U. S. Department of Agriculture has attempted this type of "composite productivity" measure, and is currently in process of revising and extending it. It should show a somewhat smaller increase than the total factor productivity measure, since in effect the same inputs are added to both numerator and denominator of our ratios.

Looking at segments of the long period, it can be seen that the average rate of productivity advance in the nonfarm sector accelerated from about 1.5 per cent a year between 1889 and 1919 to approximately 2.0 per cent annually from 1919 to 1957. There does not appear to have been further acceleration since 1919; in fact, between the last two cycle peaks, 1953 and 1957, the rate of advance was well under 2 per cent a year.

The development of total factor productivity in the farm sector falls into four phases. Between 1869 and 1899 (the first two decades of which are not shown in Table 2), productivity advanced at an average rate of one per cent a year. Between 1899 and 1919 there appears to have been a slight decline in farm productivity. This was associated with a more rapid expansion of real capital stocks than of output, but also with little or no increase in output per manhour. Between 1919 and 1937, farm productivity again advanced at an average annual rate of about 1 per cent—with both partial productivity ratios advancing at about this same rate. Then in the final phase, there has been a marked and dramatic acceleration in the rate of productivity advance to 2.7 per cent a year on average between 1937 and 1948, and 3.7 per cent a year from 1948 to 1957. At the moment there does not appear to be further acceleration; in fact, the rates of advance have slowed down progressively since 1953 to a 2.0 per cent gain between 1956 and 1957.

The figures indicate that there has been considerably more variability in subperiod rates of productivity change in farming than in the nonfarm sector. The average deviation of subperiod rates from the long-period rate has exceeded 1 percentage point in farming, compared with about one-fourth percentage point in the nonfarm economy. In interpreting this, it must be realized that the nonfarm sector is much larger and more heterogeneous than the farm sector. A breakdown of the nonfarm sector into major industrial groupings reveals as much variability in productivity advance in these segments, on average, as in farming. But the deviations of subperiod rates of advance from their mean in the nonfarm industry groups have tended to be offsetting, producing the relatively regular rate of advance in the nonfarm sector as a whole.

Annual variations in rates of productivity change are much larger than subperiod variations in both sectors. In the nonfram sector, the mean annual deviation from the secular rate is about 3 percentage points, well above the secular rate itself. In the farm sector, the mean deviation is larger both absolutely and relatively. In one important respect, the rea-

sons for the large annual variations are quite different for the two sectors In the nonfarm industries as a whole, productivity advance is substantially greater than the secular rate in years of general business expansion while in years of contraction, productivity generally falls slightly. The decline is due principally to the drop in capital productivity as measured but even output per unit of labor input rises only half as much in contractions as in expansions. In the farm economy, to the contrary, total factor productivity has actually risen somewhat more in general business contractions than in expansions-1½ per cent compared with 1 per cent, on average. Despite the fact that farm output is influenced primarily by factors other than the general business cycle, apparently the squeeze on net farm income that results from the sensitivity of farm prices to the business cycle tends to spur efficiency gains. This may also be true in nonfarm in dustries, but the adverse effect of falling rates of utilization of capacity more than offsets the tightening up of operations induced by falling profit margins.

## The Partial Productivity Ratios

We have seen that capital per unit of labor input increased significantly in the nonfarm sector, and even more so in farming. The substitution of capital for labor went on quite steadily, although in farming the capital labor ratio was virtually constant between 1919 and 1937, and then rose sharply in the next two decades. In the nonfarm sector, there was a mild decline between 1937 and 1948 due to wartime restrictions on nonessential civilian investment, but this was followed by a sharp rise in the last decade.

Despite the generally increasing trend of capital relative to labor input, savings were realized in capital usage per unit of output. In the nonfarm sector, output per unit of capital input rose by 0.8 per cent a year between 1889 and 1957, and in all subperiods except the first and last. In farming, the increase in the output-capital ratio was much more modest-0.2 per cent a year. Declines were experienced during the period of rapid capital accumulation, 1899-1919, and during the last subperiod, 1948-1957. It is noteworthy that during the earlier period, productivity actually fell somewhat, whereas in the most recent subperiod the declining output-capital ratio was associated with the highest rate of farm productivity advance on record. Output per unit of capital input has been rising again since 1952, however.

Since the output-capital ratio has been rising less than total productivity, it is obvious that output per manhour has been rising more, as a result of the substitution of capital for labor as well as the general increases in productive efficiency. In farming, output per manhour has risen at an average annual rate of 1.8 per cent between 1889 and 1957. In the

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last two subperiods, the increases have been spectacular—3.8 and 5.7 per cent, due to the heavy substitution of capital for labor and the acceleration in total factor productivity increases. In the nonfarm sector, the secular rate of increase in output per unit of labor input has been greater—2.3 per cent a year on average. In the last subperiod, 1948-57, the average rate was 2.6 per cent a year, but this was due to heavier than average substitution of capital for labor, not to an acceleration of total productivity advance.

## Some Implications of the Productivity Changes

I will leave it to the agricultural economists and others more familiar than I with farm technology to explain why there has been such a marked acceleration in farm productive efficiency since 1937, in relation both to past trends and to productivity change in the nonfarm sector, and what future prospects may be. I will suggest several areas of economic impact of the productivity trends.

Accepting for the moment the trends of real farm sales and output as given, it is apparent that the acceleration of farm productivity advance since 1937, coupled with the increased rate of substitution of capital for labor, has been an important factor in the accelerated rate of decline in farm employment and manhours worked in both absolute terms and relative to nonfarm employment and hours. There is, of course, some interaction; insofar as increased opportunity for employment elsewhere during this period is part of the explanation of an increasing exodus from farms, this may have been a factor in accelerating productivity advance. This seems plausible if the exodus were primarily from farms of less than average efficiency, or reduced disguised unemployment, and if a tightening labor market has been an element promoting acceleration in the growth of capital per farm worker and spurring efforts to improve productive efficiency generally. But insofar as the acceleration is autonomous, resulting from a flow of investions and innovations that have improved efficiency at a higher rate than earlier, then the accelerated productivity advance has aggravated the farm problem as it relates to the need for shifting labor resources. As far as capital is concerned, however, over the past two decades as in the longer-run, the farm economy has expanded its demand for new capital more in relation to its output than has the nonfarm sector.

The other point of economic impact that I should like to mention is price. Relative change in total factor productivity is an important element in explaining relative price changes, but we must remember that relative changes in unit factor compensation and in materials (i.e., intermediate products) costs per unit of output are also involved. I have made a complete partitioning of farm price changes into these constituent elements for my National Bureau study, but due to limitations of space as well as

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the limits of my topic, let me merely indicate briefly a few main features of this analysis. Between 1899 and 1937, farm prices rose significantly relative to prices of final nonfarm goods and services as a whole—particularly up to the early 1920's (ignoring the temporary World War I and immediate postwar situation). In part this was due to the smaller relative increase in productivity; but it was also due to the significant relative increase in unit material requirements and costs which we have already noted. The combined effect of these two factors was only partially offset by a smaller increase in rates of factor compensation in farming than in the nonfarm economy (although these were temporarily higher during the World War I era).

Between 1937 and 1957, the net proportionate changes in farm and nonfarm prices have been quite similar. The significantly larger increase of total productivity in farming than in nonfarm industry has been approximately offset by a relative increase in rates of farm factor compensation (despite the relative decline since 1951), and by a continuing increase in relative unit materials costs per unit of output. But the fact that farm prices in relation to nonfarm prices have shown little change over the past 20 years, in contrast to a relative rise in earlier periods, is due largely to the relative increase in farm productivity since 1937.

In conclusion, we should remember that whatever the short-term problems created by the effect of relative productivity changes on economic structure, over-all productivity advance continues to be our chief means of increasing real national product per capita. Growing real product per capita, in turn, is the basis of rising planes of living, increasing provision for future growth, and greater potential expansibility of national security outlays, if needed. The contribution of agriculture towards these goals in the past two decades has indeed been notable.

## DISCUSSION: PRODUCTIVITY TRENDS IN AGRICULTURE AND INDUSTRY

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All economists will welcome the addition of total factor productivity measurement to the more familiar and widely used partial productivity estimates. The present paper is a part of Kendrick's broader study of productivity. The careful distinction between aggregate or total output and the value added concept of unduplicated national product originating on the farm provides us with alternative output concepts, each of which is suitable for particular purposes.

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Similarly, the total factor productivity gives us a new method of measuring general efficiency in resource use which supplements the conventional labor productivity measures. It is an additional measure, not a substitute for labor productivity or output per manhour. When we wish to ascertain the general efficiency of resource use, the more inclusive measure is more appropriate. But output per manhour has a number of uses for which the total factor productivity is not appropriate, e.g. in projections, certain welfare considerations, and perhaps in wage negotiations.

An example will make this clear. Consider a period in which a substantial decline occurs in the rate of return to capital in an industry, and a comparable increase takes place in wage rates accompanied by a large substitution of capital for labor. These changes would be offsetting in terms of total factor productivity, and hence, in general efficiency of resource use. But the substantial increases in labor productivity and in wage rates have important welfare implications.

A simple but important limitation of total factor productivity is that the results are in index number form. Accordingly comparisons are limited to rates of change, with no implications as to the relative efficiency of resource use, say in farming and in nonfarm industry. The Department of Commerce has just completed a revision of Gross National Product (GNP) estimates in terms of constant 1954 dollars.¹ Using these data we have made summary calculations of total farm productivity using, first, 1910 rates of return to capital and labor and, second, 1954 rates of compensation.

As would be expected these results are consistent with those of Kendrick. On the basis of 1910 rates of return for labor and capital, the average annual rate of increase in total factor productivity for the period from 1910 to 1957 is around 1 per cent. Using 1954 rates, the increase is 1½ per cent annually. If these may be considered the practical range for bases of computation, the results include the 1.3 per cent rate Kendrick reported, using varying base weights for the several time periods. For the various sub-periods the productivity increases are also generally consistent with those shown. This indicates that the results obtained from the calculation of total factor productivity are only moderately affected by the particular base period chosen.

Let us now look at some assumptions required for the computation. The first is that the hourly wage rate for hired labor may be used for total

<sup>&</sup>lt;sup>1</sup>The totals were published in the July 1958 issue of the Survey of Current Business. The breakdown into nonfarm and farm product for the years 1909 to date are to be published in a new supplement to the Survey of Current Business, entitled "U. S. Income and Output."

labor requirements, using the Agricultural Marketing Service series on manhour requirements. This would seem to err on the side of underestimating the appropriate compensation for farm operators, but no data

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are available for a satisfactory adjustment.

A second and corollary assumption is that for the base period the return to capital including land, buildings, machinery and equipment, and inventories is the residual after labor input is subtracted from farm GNP. The rate of return to capital is then derived by taking this residual return (of total farm GNP less labor input) as a percentage of the total value of capital. This rate of return is then applied to the value of capital in constant dollars for other years. The sum of the labor input and the capital input equals the total factor input which is then related to output to obtain the change in total factor productivity.

Since the required capital estimates and value-added output are available for agriculture, the calculations are quite straight forward and direct

A word seems appropriate concerning the contribution of the principal types of capital input, which are derived directly from constant dollar capital estimates of the Department of Agriculture. The capital inputs are dominated by real estate. Thus, at the present, the real estate estimate is seven times as large as the machinery and equipment figure. Also, the absolute change in the real estate constant dollar estimate is greater than the change in machinery and equipment over long, intermediate, and even relatively short periods of time. This is surely in conflict with the general idea that the revolution "down on the farm" has been principally in machinery rather than in the volume of farm real estate.

A partial explanation is that the machinery and equipment estimates are net depreciated value (in constant dollars). Although this seems to be the appropriate concept for the specific purpose here, the depreciation appears to be rather greater than the actual decline in productivity of farm machinery and equipment. Thus, the constant dollar estimates of machinery and equipment show no appreciable rise since 1951 despite a considerable increase in the number of tractors and other principal pieces of farm machinery. The constant dollar estimates are only about double 1940 or 1925, whereas the number of the principal machines is up several fold in this period, and the work capacity of most of the machines has increased substantially.

Kendrick suggests that indirect evidence points to no appreciable shortening in the farm work week, and he offers a possible interpretation of this maintenance of hours of work on the farm in contrast to the shortening in hours of nonfarm work. The AMS has collected data on hours worked per day for the beginning of June, September, and December each year since 1940 and the Census Bureau has collected estimates of es on

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of enener of hours worked per week for one week in each month since 1941. Each of these series shows appreciable declines in the working day or the work week both from prewar and since the end of the war. In both series a rise in hours during the war was reversed at the war's end, and an irregular but marked downward trend has prevailed since that time. This seems intuitively more reasonable than the indirect evidence that the long farm work week has been maintained.

Finally the secular rise in the ratio of intermediate products to aggregate farm output in constant dollars, which Kendrick noted, has not continued in the past decade. Although the rise to 1947 had been substantial, since then the ratio of intermediate to aggregate product has shown moderate annual fluctuations but no persistent tendency to rise further or to decline. The ratio in 1957 is the same as in 1947. The current dollar ratio, however, of intermediate to aggregate product has advanced steadily since World War II.

# CHANGING RELATIONSHIPS BETWEEN AGRICULTURE AND THE NATIONAL ECONOMY

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WILLIAM A. CROMARTY Michigan State University

HANGING relationships between agriculture and the remainder of the economy certainly go beyond technical bounds, and the effects of changing relationships are not confined solely to agricultural prices and incomes. In fact, some of the most important changes have occurred in the political and institutional fields, and have been effective in shaping the values and beliefs of the farm people as they view the nonfarm economy.

As a result of the generality of the assigned topic, this paper is not confined to technological changes but, rather, attempts to evaluate some of the changing relationships under these sections: (1) Production processes; (2) Consumption processes; (3) Political activities; (4) Attitudes

toward political and institutional factors.

A complicating feature in developing a paper suitable for the imposed title is the selection of time periods in which comparisons of relationships may be made. An investigation of agricultural-nonagricultural relationships reveals that some are recurring in nature. Apparent changes between the two sectors in many instances are a result of phases of the business cycle rather than any permanent structural change. In fact, for this reason, a paper concerned with the nonchanging relationships between agriculture and the national economy may be just as apropos. Relationships in the United States only will be considered.

## Production Relationships

Under the general heading of production relationships may be classified changes in farm produced inputs such as labor, or nonfarm produced inputs; the techniques of producing; the methods of financing production; and the result of production, namely income. Perhaps the most obvious relationship between the two sectors which has changed has been the proportion of population on farms and in other industries. In 1910 about 35 per cent of the nation's population resided on farms. This has declined quite consistently until at the present time only about 12 per cent of the population resides on farms.¹ This movement of population from farms has been of great magnitude notwithstanding policy recommendations for speeding up off-farm migration as a solution to the farm income problem. From 1910 to 1957 the migration from farms reduced the farm population

<sup>&</sup>lt;sup>1</sup> Farm Income Situation, Agricultural Marketing Service (AMS), USDA, p. 23, July, 1958.

38 per cent. It represented a 37 per cent decrease from 1940 to date and a 20 per cent decrease from as late as 1950 to date. Recent projections on the farm *labor* force indicate that it will continue to decline over the next decade. Bonnen<sup>2</sup> has estimated that the 1965 labor force in agriculture for the United States will decline by at least 1.7 million persons over the 1955 figure of 6.7 million.

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The implications of such a migration are far reaching. When combined with the increase of capital flowing into agriculture, it provides for greatly increased physical productivity per worker. During the period 1940 to 1956 capital per worker in agriculture, measured in constant dollars, increased by 64 per cent. By comparison, capital per nonfarm worker increased about 35 per cent in the 1940 to 1956 period, and it is estimated that in 1956 capital assets per worker in agriculture were 250 per cent of those in nonfarm industries.3 Yet, in spite of the changing relationship between capital invested per worker in farm and nonfarm industries, the marginal value productivity per worker employed in agriculture has fallen below that of his counterpart in industry. One of the important reasons for this is the different demand structures facing the two economies. The low demand elasticities for farm products relative to nonfarm products have caused farm prices to fall relative to those for nonfarm goods. This leads to lower value productivities for farm labor. In addition the increased bargaining power of industrial workers has caused their relative wages to rise either in terms of absolute dollar levels or by the addition of other social benefits. Although money incomes are not equivalent to marginal value productivities, the same reasons hold true for the divergence between farm and nonfarm incomes. Based upon 1910-14 = 100, the following table contrasts the rise in net farm incomes and annual wages for industrial workers for the period 1920 to date.

Table 1. Average Annual Incomes of Employed Farm Workers and Workers in Manufacturing, 1920–57\*

		$\begin{array}{c} Manufacturing \\ 1910-14 = 100 \end{array}$
1920	195	247
1930	135	218
1940	143	236
1945	448	416
1950	502	557
1957	530	773

<sup>\*</sup> Source: Farm Income Situation, AMS, USDA, Washington, D. C., July, 1958, p. 25.

<sup>&</sup>lt;sup>2</sup> James T. Bonnen, *Policy for Commercial Agriculture*, Joint Economic Committee, 85th Congress, 1957, p. 150. This represents a net movement from farms and underestimates the total movement from farms because of higher rural birth rates.

<sup>&</sup>lt;sup>3</sup> E. O. Heady, "Adjusting To Economic Change," Journal of Farm Economics, December, 1957, p. 1339.

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Only during the years 1945-48 when farm prices rose rapidly were farm

incomes above those of workers in manufacturing.

While little hope can be held on the demand side for increasing the value productivity returns to farm labor, their position will be improved as the net migration out of agriculture continues and additional capital enters. During the past 15 years or so increased returns to agricultural workers have been gained only by the rapid adoption of production in creasing techniques in an era when the domestic plus export demands for food and fibre were very high. Such a situation is not likely to prevail in the next 15 years, and if returns to agricultural labor are not to fall far behind that of industry, some techniques other than increased production per acre must be found. The only real hope is a combination of the outflow of agricultural workers and the inflow of capital into agriculture which is labor-saving in nature. In industrial states, such as we have in Michigan, labor mobility is high and only small positive differentials in industrial wages are needed before farm workers drift into industry jobs. The vacated land, whether consolidated or left idle, will not necessarily result in increased production, but the returns to the remaining agricultural workers may be increased. This is especially true if they are able to adopt labor-saving production techniques and may result in their returns keeping pace with those of industrial workers.

Accompanying the shifts in labor and capital between agricultural and the national economy has been a trend in agriculture towards the purchase of more nonfarm produced inputs as variable factors of production. There is some difficulty in separating secular trend from business cycle reactions, but for such commodities as fertilizer, lime, petroleum products, hybrid seed corn, and prepared feeds there has been a secular increase in purchases which has even overridden cyclical effects. The nature of the changing relationship is important in two respects. First, it points up the growing interdependence of the two economies. Certain industries of the nonfarm economy have a significant economic interest in the level of such purchases. Secondly, as more of these inputs become variable rather than fixed, it may cause the aggregate supply curve for agriculture to become more elastic. The elasticity of the supply curve has also been affected by the level of opportunities for off-farm employment. The labor input in agriculture has been reduced and more variable factors substituted for it only as industrial growth occurred. Such a phenomenon was of much more importance in the pioneer days than in the last decade, but we may still expect that satisfying opportunities in nonfarm areas will continue to transform the relatively durable and fixed asset of agricultural labor into

something less durable.

<sup>&</sup>lt;sup>4</sup> For a definition of variable inputs see G. L. Johnson and L. S. Hardin, "Economics of Forage Evaluation," Purdue Agricultural Experiment Station Bulletin 6<sup>23</sup>, April, 1955.

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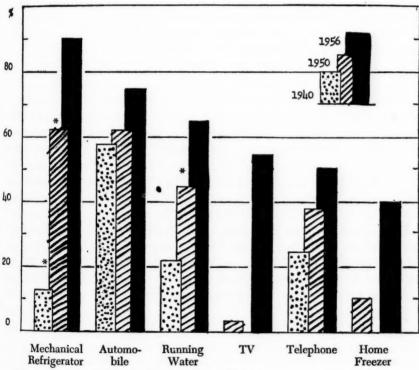
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"Econ 623, One financial relationship between agriculture and the national economy which has undergone some change and promises to undergo even more change is the trend toward vertical integration. The increase in production specialization in agriculture accompanied by the need for sufficient capital to undertake such production will continue to encourage such integration. Accompanying this process will be changes in the terms of exchange between agricultural producers and industrial marketing or supplying agencies. Commensurate with vertical integration is a trend towards more standardization of product forms to suit marketing agencies and consumers. This too approaches the more clearly defined concept of standardized production in industry.

### Consumption Processes

There is no doubt that rural living in the present day United States is approaching that of the urban society. The growth of household facilities from 1940 to 1958 in farm homes has been extraordinary. Figure 1 pre-



\* Rural-Farm Households with Specified Facilities.

Source: Farm Outlook Charts, USDA, Washington, D.C., 1958, p. 57.

Fig. 1. Proportion of farm-operator households with specified facilities

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sents a visual aid to evaluating such changes in the percentages of rural farm households having specified facilities.

Farm families are also spending more for family living than in previous years. Two surveys,<sup>5</sup> conducted in 1941 and 1955, show that in terms of 1955 dollars the average expenditure per family was \$2,760 in 1955 compared to \$1,716 in 1941. Expenditures are also being divided differently by farm families. The proportions of the total that were spent for food and transportation were the same in 1955 as in 1941; those for housing, medical care, and recreation and education were larger in 1955 than in 1941, while those for clothing and miscellaneous items were smaller. While farm families still lag behind urban families in the amount of money they spend for each of these categories the data show that the gap is narrowing. In 1955, total spending of the average farm-operator family for current consumption amounted to 48 per cent of the expenditure of the average urban family. In 1941 it was only 30 per cent.<sup>6</sup> The various proportions spent in each category of farm family living as a percentage of urban families are presented in Figure 2.

Part of the apparent disparity is accounted for by the difference in price levels facing urban and rural purchasers. Although recent estimates are not available, there is some evidence that in earlier years the price differences were also being narrowed.<sup>7</sup>

#### Political Powers

The history of American politics is rich with the exploits of American farmers as a source of political power. Land settlement problems and the money system were long recognized as policies affecting farmers' positions. Farm reaction to government legislation on these two scores has varied from antipathy and distrust in the early settlement years through violent protest in the 1870's and '80's leading up to a demand for pressing reforms. The voting strength of farmers as individuals probably reached a peak with the rise of the Populist party or the Farm Bloc.

Early demands were for legislation aimed largely at inflation of currency and control of the railroads. In the 1920's the slogan became "equality for agriculture." Since 1938 agricultural reform legislation has had as its central theme the supporting or increasing of farm prices. When the history of agricultural political power is compared to the legislative power

<sup>&</sup>lt;sup>5</sup> Farm Outolook Charts, USDA, Washington, D.C., 1958, p. 57.

<sup>\*</sup>Ibid.

N Koffsky Studies In Income and Wealth Vol 11 Nation

<sup>&</sup>lt;sup>1</sup> N. Koffsky, Studies In Income and Wealth, Vol. 11, National Bureau Economic Research, Princeton: Princeton University Press. In this article Koffsky and discussants Margaret Reid and Ernest Grove present data on the reasons why such price differences exist. Koffsky concluded that the 27 per cent price disparity which existed in 1941 had been reduced to about 18 per cent in 1945.

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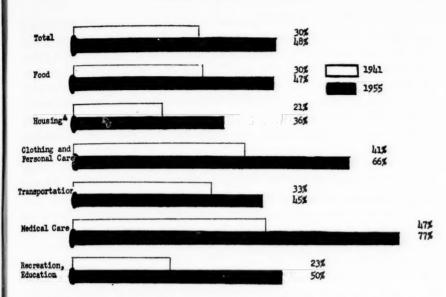
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 $^{\circ}$  Farm-Operator Families  $^{\circ}$  Per Person  $^{\Delta}$  House upkeep, Operation, Furnishings, and Equipment.

1955 Data adjusted for comparability with earlier surveys.

Fig. 2. Farm<sup>®</sup> Family, Spending as a per cent of urban spending<sup>®</sup>

of labor groups, there is good evidence of a vastly changing relationship during the last half century.

The labor movement had very little voice in national legislative actions until the New Deal program arose. Not until the Wagner act of 1935 did labor make a major break-through. Legal permission for laborers to organize and collectively bargain through representatives of their own choosing was the Magna Charta of the labor movement. Labor power continued to grow throughout the war years and took a position of strength in the Democratic Party.<sup>8</sup>

Unlike the early farm movements, the labor unions did not favor a third party<sup>9</sup> but supported those candidates who shared labor's views. The postwar strikes of labor unions were largely victorious; so employers shifted to the legislative field to curb labor's power. The result of this was the Taft-Hartley law of 1947 which partially counterbalanced labor's power. Although John L. Lewis suggested that labor bypass it in its activities, no real counter offensive was ever started.

\*For a more complete appraisal of labor unions current position see Bert Cochran, Monthly Review, Volume 10, July-August, 1958.

In 1943 when the CIO Political Action Committee was established, President Philip Murray stated "It is not the policy of the CIO to organize a third party," reported in Joseph Gaer, *The First Round*, 1944.

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Labor, much like agriculture, had learned to rely upon government boards and depend upon government mediators in the postwar period. For the past decade labor has been on the defensive and has been primarily interested in gaining respectability. Given a minimum level of securily they have adopted a conservatism which was increased by the adoption of AFL policies after the CIO-AFL merger. For all the membership of some 20 million members the unions have generally been indifferent to the important questions of our time. No firm public stand has been taken on the cold war or co-existence, nuclear bomb tests, colonial freedoms or the current depression. Currently the labor unions have become just another "special interest" group in the mind of the public. They no longer represent a focal point for reform legislation.

The next decade will probably see a strong labor union movement which will overshadow any political strength agriculture may have. The various punitive actions taken by government currently will stir the unions to enlarge their political influence. This could very well come as a third party representing labor as happened in Great Britain. The labor unions have come to favor government legislation as a means for gaining their ends. "Its objectives are . . . to promote substantive objectives with respect to terms and conditions of employment through legislation rather than at the bargaining table." This has a striking similarity to the methods.

ods followed by the major farm groups.

#### Attitudes Toward Institutional Factors

The attitude of agriculture toward the growth of labor power has been one of the changing relationships to note. In colonial days farmers and labor were largely one corporate body and early farm movements were often begun as labor movements, e.g. the Populist Party was an outgrowth of the Union Labor Party which met in Ohio in 1872. In succeeding years several attempts were made to join agriculture with labor parties. The Farmer-Labor party of the Midwest and the current Farmers Union organization were such examples. However, after the rapid growth of labor unions in the war and postwar periods, farmers' attitudes towards them have changed. The early possibilities of organizing farm labor caused some apprehension on the farm. More important is the threat of the monopoly power of unions to tie up transportation facilities which are of vital concern to agricultural producers. On the other hand, farmers have had a vital interest in improving the wages of especially the low earning industrial workers who had high demand elasticities for food because it meant an expanding market for food products. However, it is not high

<sup>&</sup>lt;sup>10</sup> As reported by John S. Bugas, Vice President, Industrial Relations of Ford Motor Company in a talk at East Lansing, Michigan, April 24.

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wage rates which are of ultimate concern to farmers but high employment and adequate money incomes. This at times runs counter to the seniority systems adopted by labor unions. To cite an example of the changing attitudes of farmers toward labor unions, an excerpt is taken from the policies of the Michigan Farm Bureau. These policies called for amendment of the Taft-Hartley law which will make possible effective damage and injunction proceedings against offending unions . . . participating in secondary boycotts, insistence that compulsory unionization, as exemplified in the union and closed shop, be prohibited (since these practices) nullify the very fundamentals of individual freedom, and to prohibit the use of union dues for political purposes.

In contrast, the attitudes of labor unions have been to encompass farmers as a part of the labor movement. Farm interests have often been held up as common to labor interests, and union organizers have attempted to enter the agricultural field to aid in controlling the marketing of farm products.

Farm people, as well as urban workers, have generally favored a "reflation" or "inflation" of money. There is some indication that divergencies currently exist in this regard. Money inflation has consistently been one of the boons to farmers and urban homeowners who have had high fixed costs to meet and whose debts have been high relative to equity. However, the peculiarity of the economic climate in the past decade and especially the past four years or so has done much to soften farmer attitudes toward continuous inflation. While it is true that historically farmers have used inflated capital assets as a buying base, the last few years have seen a situation where inflation has done little to enhance farm product prices but has resulted in increased farm input prices. The well known cost-price squeeze as a result of such creeping inflation has probably tempered farmer enthusiasm for continuing inflation. To quote the Michigan Farm Bureau, "Inflation has again become one of the most serious dangers facing our nation."12 This is a far cry from the demands of the Greenback or Populist parties or the cries of the major national farm organizations in the mid-thirties. Businessmen<sup>13</sup> share such feelings with farmers for they too are input users. The changing relationship lies in the divergence between labor sellers who favor a continuous inflation and the farm population who as entrepreneurs have tempered their desire for a continuous infla-

<sup>&</sup>lt;sup>11</sup> 1958 Policies of the Michigan Farm Bureau, 38th Annual Meeting, East Lansing, November 12-13, 1957, p. 27.
<sup>12</sup> Ibid, p. 25.

<sup>&</sup>lt;sup>13</sup> For instance see an address by T. O. Yntema, Vice President, Ford Motor Company, delivered to American Life Underwriters Association, Chicago, Ill., October 11, 1957.

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Institutional arrangements to provide retirement security for farmers have historically been bitterly opposed by farm groups. Their pioneer attitudes of optimism and their traditional dependence upon eventual farm ownership which would provide old age insurance were in opposition to security provided by governmental sources. By comparison, security in unions and among civil servants has always been emphasized whether it was private or publicly supported. The Social Security act of 1935 did much to serve industrial workers needs, and by 1940 more than 50 million workers had contributed toward it.14 Farm organizations did not welcome strongly the proposal but "continuing pressure for broadening the coverage of the system, particularly by the administration, led to the passage ... of the Social Security act amendments of 1950."15 This has led to active participation by farmers who have turned to welcome the aid in much the same way as their city cousins. It may be that the continued threat of inflation in future years will serve to strengthen the dependence on public and private pension funds instead of the historical reliance on individual savings. One implication of the acceptance of Social Security by farmers is that it may very well decrease the average age of farm operators by retiring from active farming many of the operators 65 years of age or more.

Farm and national attitudes toward conservation have also undergone changes in the past. Soil conservation policies have had almost universal support in agriculture, and the widespread drought of 1934 gained conservation measures much public sympathy. The educational tirade by the Malthusian believers has done much to present agricultural conservation proposals as virtuous ends in the eyes of the nation. This has made it possible for income raising policies to be clothed in conservation terms and yet have considerable appeal to nonfarm groups. In addition, conservation proposals often carry a connotation of wild life and recreational promotion which again results in a currently strong acceptance by the nation for conservation measures.

Perhaps one of the most important relationships between the farm and national economies which has undergone change is the attitude of both groups toward education. The accepted belief in agriculture that off-farm migration is a solution to the low farm income problem has caused more thought to be given to the preparation of rural people for urban ways of life. The extension services have developed programs which extend this belief. "All of the agricultural agencies, in cooperation with other interested groups and organizations, are making an effort to persuade agriculture, industry, education, and the social community to join their resources and capabilities to make possible sufficient opportunity for a respectable

<sup>&</sup>lt;sup>14</sup> Benedict, op. cit., p. 371.

<sup>15</sup> Benedict, op. cit., p. 372.

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per capita income either in or outside the community." <sup>16</sup> This type of statement points up the need for joint effort on the part of rural and urban people to find a solution for the education of rural people, especially those who will migrate from low income farms. The rapid movement of many farm people into such metropolitan areas as Chicago or Detroit emphasizes the need for joint solutions on problems of assimilation and education. From 1940-50 an estimated 8.6 million persons moved from farms to nonfarm areas and from 1950-56 the net movement included an additional 5.1 million persons. <sup>17</sup> Policies needed to facilitate off-farm migration and the assimilation of these people have been outlined by D. Gale Johnson and need no further explanation here. Urban areas have come to recognize the need for improved primary and secondary education for youth in rural low-income areas, and a better understanding by these young people of jobs available, occupations, and types of training needed for industrial employment.

Education-wise there has also been a change in the programs undertaken by extension agencies in the land grant colleges. For instance, in the state of Michigan there has been a rapid increase in the number of nonfarm 4-H club members. In 1945 about three quarters of all club members were classified as farm members. In 1957 this had dropped to one-half of the members. Nationally, over the period 1950 to 1956, the percentage of farm members dropped from about 77 to 62 per cent. Extension programs have also tended towards a larger proportion of time being spent with marketing agencies handling farm products as compared to producers of the products. Such a trend is almost certain to continue in future years.

### Summary

One of the most obvious and consistent changes has been the net movement of farm people to urban areas and/or industrial jobs. Since 1940 approximately one million persons per year have been included in this movement. Forecasts are for a further decline in farm population and labor force. Concurrent with the labor movement out of agriculture has been the inmovement of capital. These two factors increased the earnings of agricultural labor in a period when the demand for food and fiber were high. Future increases in the returns to farm labor as compared to industry will be largely dependent upon a further migration of labor out of agriculture and the adoption of labor-saving techniques.

<sup>&</sup>lt;sup>16</sup> Statement by E. J. Nesuis, University of Kentucky, in a paper published in Agricultural Adjustment Problems in a Growing Economy, Iowa State Press, 1958.

<sup>&</sup>lt;sup>11</sup> D. G. Johnson, "Labor Mobility and Agricultural Adjustment," Agricultural Adjustments In A Growing Economy, Iowa State Press, 1958. In addition Johnson reports that another 3 million farm people were involved in job movements but not a change of residence in the 1940-56 period.

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Agriculture has relied heavily upon financing through the increased valuation of capital assets as compared to internal financing in industry. This in part explains farmer acceptance of inflationary periods. However, the trend toward financing through vertical integration and the cost-price squeeze of the past few years may soften farmer attitudes toward continued inflation.

Farm households are approaching those of urban dwellers with respect to both the facilities available and the manner in which expenditures are

being proportioned for family living.

Politically, the power of farmers has declined and is likely to continue to decline relative to the remainder of the economy. Political methods in agriculture have undergone changes varying from protestation, the formation of a third party, the organization of a Farm Bloc, to the support of individual candidates supporting acceptable farm policies. Policies have also changed from an emphasis on inflation, railroad control and land settlement, to equality slogans and price supporting measures. Labor, meanwhile, has evolved as a stronger political power with current tendencies also swinging in the direction of reliance on government legislation as a method of bringing reforms.

Farmer attitudes toward labor unions have also changed, from one of "brothers in arms" to a recognition of labor unions as a threatening power over agriculture. As security seekers, the attitudes of farmers are beginning to parallel those of industrial workers and as conservationists, urban people voice little disapproval with farm income supporting legislation

clothed in conservation terms.

With the respect to attitudes toward education, there is developing a mutual recognition for solving the educational needs of people who migrate from farm to city areas.

# DISCUSSION: CHANGING RELATIONSHIPS BETWEEN AGRICULTURE AND THE NATIONAL ECONOMY

PHILIP T. ALLEN
Federal Reserve Board

The topic assigned to Cromarty was a big one for a 15-minute paper or even for a good sized book. In covering this broad assignment he chose to touch on a wide range of subjects. Perhaps he did well not to limit the subject at the outset or to simplify his analysis into a few sweeping generalizations about the decreasing relative importance of agriculture or the disappearing differences between agriculture and industry. One result of this approach, however, is that a reviewer finds no distinct central thesis to take issue with or support.

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Thus, while Cromarty raises a number of thoughtful and provocative ideas, he does not develop them very far, so one has to guess at what he considers to be their broader implications. I am, therefore, guessing when I say that Cromarty generally appears to be more optimistic than many about the future of agriculture, and feels there is a fair prospect of the difficulties being resolved without great stress and strain. I will note the statements in his paper that lead me to feel he is optimistic, comment on these and a few other statements, and then raise a general question about the future of the farm price support program.

In the first place, Cromarty notes that the decline in the farm population, while rather "consistent" since 1910, was at a more rapid rate from 1950 to 1957. He also hints that the farm labor force may be becoming "less durable . . . and fixed" than earlier. He observes that farm incomes on a per capita basis have risen in recent years relative to nonfarm incomes. He says that in industrial states, such as Michigan, there need no longer be a much higher relative return for industrial workers to cause farm laborers to move into nonfarm jobs. When in addition to all these, one considers that industry is moving into areas that formerly were rural, such as the South, and that many farm families now have relatives or friends who are working in part or full-time nonfarm jobs so that such work is more likely to be within their own range of possible alternatives, perhaps a case can be made that a still faster decline in farm population is in the picture for the future. I would like to hear Cromarty comment further on the likelihood of such a development.

He also seems optimistic that farm technological advances in the future, in contrast with the past 15 years, may be more "labor saving" and less "output increasing." I wonder if the distinction is really significant? If labor were saved on a farm by a new technique, there would seem to be an incentive for the farmer to utilize the saved labor by expanding his output by one means or another.

Finally, Cromarty observes that levels of rural living in recent years have made great advances in relation to urban levels—an advance he expects will continue. No doubt this has reflected in part such federal programs as the Rural Electrification Administration. But farmers also seem to be spending more heavily for consumption in relation to their earnings than they did at one time—at least they were in 1955 compared with 1941. Does this mean farmers may not be so ready to plow their earnings back into new technology or enlaregd holdings as they have been in the past? Assurance of social security benefits on retirement could be another factor tending to change farm attitudes toward wealth accumulation. Such changes might prove something of a curb on future technological developments.

So much for Cromarty's apparent optimism as I see it. I will now men-

tion a few unrelated points that could be explored further. He indicates that since farmers now buy more things off the farm than they used to they may now be against inflation. I hope this is right. However, his state ment that "money inflation has consistently been one of the boons to farmers" seems wide of the mark except from a rather short run point of view. The inflation of the World War I, as an outstanding example, was followed by a period of troubles two decades long, in which around one-third of all farmers lost their holdings through foreclosed mortgages.

The section of the paper on differences between agriculture and industry in methods of financing their operations was not clear to me. There are doubtless many interesting contrasts. Cromarty observes that the capital used per farm worker in a recent year was 2½ times that of the nonfarm worker. The growth in farm capital needs has been great and these and other developments in farm finance seem to have outdistanced the research about them. Comparative studies in industrial-agricultural finance ing, as well as other studies, should be rewarding.

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A statement heard frequently these days is that the lines between the agricultural and the nonagricultural economy have become less and less distinct, and that this development has broad implications-influencing the definitions of agriculture, the role of agricultural economists, the sources of political power, and the like. I wish Cromarty had given us his view of the current status of "agribusiness" thought-or has this type of relationship not really been altered much in recent years? He does mention vertical integration of farming but not in terms of closer interdependence between farmers and industry.

Cromarty comments on the rise of the political power of labor and the decline in that of agriculture. In fact, he ranges far afield on the subject of labor unions. While a number of his statements would bring vigorous arguments from persons who study labor closely, these statements are not an essential foundation to his conclusion that labor will increasingly overshadow agriculture in Congress. This might naturally lead to a consideration of the current farm price support program and how it may be changed in the future. Surely the relative growth of this program, its current very large costs, and its effect on farm prices and incomes, as compared with earlier periods, are changing relationships worthy of note whether the program is considered as permanent or not.

Personally I feel the idea of lower farm support prices and lower federal budget costs might have considerable appeal in years ahead to the 9 out of 10 people in the nation who will not be farmers. The large jump in crop output this year emphasizes anew the problems inherent in the current program. As agricultural economists I feel we should be seriously studying the effect that potential changes in the farm program might have and suggesting ways these programs could be made more useful to the

whole economy.

# IMPLICATIONS OF CHANGING TECHNOLOGY FOR PRICES AND INCOMES IN AGRICULTURE

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M. A. MACGREGOR Ontario Agricultural College

Technology is probably one of the chief factors in our fight to contain the "Malthusian spectre." While our society without technology may have long since reached the starvation level, we, in the western world at least, occasionally lay some of the blame for our chronic surpluses at the door of technology. Perhaps we can have too much or too little technology. No attempt is made to answer this question. Technology is treated on the assumption that technological change or development is a necessary condition for economic progress.

It is perhaps relevant that production is missing from the assigned title. There is at least one reason for this; the literature on the economics of technological change is rather scarce and spotty, but most of the references concerned with this problem deal mainly with the implications of technological change for production.

Some attempts have been made to deal with the implications of technological change for prices and incomes on a commodity and industry basis. In this vein Earl O. Heady gives a well-developed analysis of the implications of technological advance on the income and welfare positions of farm people.<sup>1</sup>

The major objective of this paper is to assess the implications changing technology will have on prices in agriculture. The implications for incomes in agriculture will be dealt with in a more cursory manner partially because the connection between technology and incomes is more tenuous and difficult to unravel than the connection between technology and prices. To make the assignment still more manageable the aggregative approach is used, i.e. agriculture vis-à-vis the rest of the economy.

In this assignment some particular terms of reference were suggested; they were, (1) "consider how changing technology is affecting prices and incomes in agriculture and what future trends may bring;" (2) "consider also that the fruits of technology appear to be translated into declining prices for farm products while prices hold steady or rise in the nonfarm economy." The above points are considered in the following analysis.

#### Theoretical Model

No manageable model is completely realistic; however, a simplified model is often useful as a framework of attack on a problem. The model

<sup>&</sup>lt;sup>1</sup> Earl O. Heady, "Basic Economic and Welfare Aspects of Farm Technological Advance," *Journal of Farm Economics*, May, 1949, pp. 293-316.

that follows can be severely criticized on several accounts. It is intended to serve as an hypothesis, or tentative theory, of the implications of changing technology for prices in agriculture under some quite broad and far reaching assumptions.

The economy is divided into two sectors, agriculture and nonagriculture. Two models are constructed, a production model and a consumption model.

The production model is  $\frac{X^2}{a^2} + \frac{Y^2}{b^2} = 1$ , where X = per capita produc-

tion of nonagricultural goods, and Y = per capita production of agricultural commodities. This production model indicates that if all resources were employed in agriculture, the per capita agricultual output would be equal to "b"; the total nonagricultural output would be equal to "a" if all resources were employed in nonagricultural pursuits. This production model does not allow for complementarity in production. Adjustments could be made for this defect, but this further complication is not considered necessary as we are mainly interested, from an economic standpoint, in the competitive range of the production possibility curve.

A change in technology is defined as any change that shifts the production possibility curve. Consequently, a change in technology in the agricultural sector changes the structural coefficient "b" to "b<sub>1</sub>"; the structural coefficient "a" is not changed (Fig. 1).

Per Capita
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Production

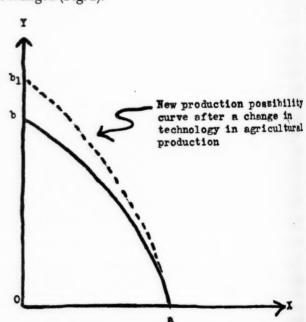


Fig. 1. Per capita non-agricultural production

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The consumption model is UV=c, where U=the per capita consumption of agricultural products and V=the per capita consumption of nonagricultural products. In this model c is a structural coefficient and might be interpreted as representing real income.

Assuming that what is produced is also consumed, then U = Y and V = X. The production model and the consumption model can now be put together to determine the ratio of exchange for agricultural and non-agricultural goods (Fig. 2). The indifference curve is convex to the origin; the production possibility curve is concave to the origin. Therefore, any

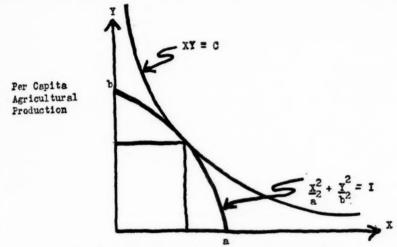


Fig. 2. Per capita non-agricultural production

one production possibility curve is tangent to only one specific indifference curve; one unique point of tangency of these two curves exists. At this point of tangency the slopes of the two curves must be equal. It can be demonstrated that the slope of both curves at this point of tangency

is equal to  $\frac{-b^2}{a}$ . As the absolute value of this ratio becomes smaller, i.e.

The slope of the production possibility curve  $\frac{dy}{dx} = \frac{-b^2x}{a^2y}$ . The slope of the consumer preference curve  $\frac{dy}{dx} = \frac{-y}{x}$ , which is independent of the parameter c. Equating the slopes of these two curves  $\frac{b^2x}{a^2y} = \frac{y}{x}$ ,  $b^2x^2 = a^2y^2$  and  $x = \frac{+a}{-b}y$ . Substituting the positive value for x into the original equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ,  $y = \frac{b}{\sqrt{2}}$ ,  $x = \frac{a}{\sqrt{2}} \cdot \frac{-y}{x} = \frac{-b}{a}$  the slope of the consumer preference curve at the point of tangency with the production possibility curve.

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"a" increases in magnitude relative to "b," the ratio of exchange of agricultural commodities to nonagricultural commodities decreases; the prices of agricultural commodities rise relative to the prices of nonagricultural b

commodities. As the ratio  $\frac{D}{a}$  increases, the prices of agricultural products fall relative to the prices of nonagricultural products.

One further proposition of importance is that any straight line through the origin intersects the indifference curves at equal slopes. The slope of

any difference curve is  $\frac{-y}{x}$ ; the slope of any given straight line through

the origin is a constant and is equal to  $\frac{y}{x}$ . These slopes are equal in absolute value which substantiates the proposition stated above.

We are now in a position to assess the implications of a change in technology for prices in agriculture on the basis of the postulated production and consumption models. From an equilibrium position the effect on agricultural prices of a change in technology in agriculture is illustrated (Fig. 3). Before the technological change in agriculture per capita agricultural production is OE, nonagricultural production OI; total production in the economy is represented by the rectangle OEKI. Immedi-

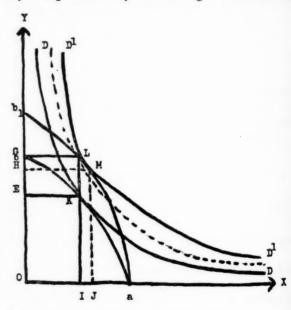


FIG. 3. PER CAPITA NON-AGRICULTURAL PRODUCTION

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ately after the change in technology in agriculture, agricultural production increases to OG; there is no change in nonagricultural production. Total production is now equal to OGLI. At the point L the production possibility curve is not tangent to a consumer preference curve. This is not an equilibrium position. At this position the prices of agricultural products have declined relative to the prices of nonagricultural products. Therefore, the initial impact of technological change in agriculture is increased agricultural production with the prices of agricultural products declining relative to the prices of nonagricultural products.

In order to move from the position OGLI to the new equilibrium position OHMJ, it is necessary to shift resources from the agricultural to the nonagricultural sector. However, in arriving at the new equilibrium position M, the prices of agricultural products rise relative to those of nonagricultural products but this price ratio at the new equilibrium position M is still lower than it was at the old equilibrium position K.

The implications of a change in technology in only the agricultural sector for prices in agriculture postulated by this model are as follows: (1) Initially there is an increase in agricultural production, no increase in nonagricultural production, and the prices of agricultural products decline relative to nonagricultural products; (2) to reach a new equilibrium position resources move from the agricultural to the nonagricultural sector; (3) at the new equilibrium position both agricultural production and nonagricultural production increase; and (4) at the new equilibrium position the prices of agricultural products are lower relative to nonagricultural prices than they were at the original equilibrium position but the price ratio has improved in favour of agriculture from the initial impact of the change in technology on agricultural prices.

To assess, on the basis of the model, the general implications of a change in technology for prices in either of the two sectors consider the

ratio \_\_\_. This is the exchange ratio of agricultural products to nonagricul-

tural products at an equilibrium position of consumer preferences and production. A change in technology in agriculture increases "b" while a change in technology in the nonagricultural sector increases "a." There are three general propositions that are relevant for the implications of a change in technology for relative prices in the two sectors.

(1) A change in technology in one sector and not in the other sector reduces the prices in the sector in which the change in technology occurs relative to the prices in the other sector.

(2) Equal proportionate changes in technology in both sectors do not

change the price ratio i.e. the value of  $\frac{b}{a}$  does not change.

(3) If  $\frac{b}{a}$  < 1 or > 1, then equal absolute changes in both sectors cause

this ratio to have a limiting value of 1.

One other important implication, implicit in the above analysis, of a change in technology for agricultural prices is the following. As the production possibility curve shifts outward to the right the same absolute changes in technology in either sector have less and less effect on the exchange ratio of the goods in the two sectors. If the production possibility coefficients "b" and "a" are equal to 4 and 2 respectively, then the equilibrium exchange ratio is equal to 2. If "a" is increased by 6 units then the exchange ratio declines to one half. If the production possibility coefficients "b" and "a" are equal to 16 and 8 respectively then the equilibrium exchange ratio is again equal to 2; but if "a" is now increased

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by 6 units then the exchange ratio declines to only  $\frac{16}{14}$ . Thus, as the pro-

duction possibility curve expands the same absolute changes in technology result in progressively smaller changes in the exchange ratio.

This completes the generalized model of production and consumption and effects of a change in technology on agricultural prices relative to nonagricultural prices. As indicated previously this model is open to many serious questions, but if it gives some insight into the general forces of the impact of technology on agricultural prices then it serves a useful purpose. The problem is now one of trying to marshal some evidence to determine whether or not this model can be used to arrive at some reasonable conclusions concerning the impact of technology on agricultural prices.

Available Historical Data Relevant to the Model

It is extremely difficult, perhaps impossible, to obtain adequate quantitative measures of general technological change or even of specific technological changes. Two measures, for which data are available, that give some indication of the extent of technological change are (1) production per unit of labor and (2) per capita production.

It would be desirable to obtain data for production per unit of capital and production per unit of land. It was not possible to obtain the required data for both sectors in order to calculate the above measures that were

meaningful for comparative purposes.

One of the major problems in dealing with the empirical data is maintaining the unit of measurement constant over time; this and the aggregation problem are common to all our production and price indices. Some

Table 1. Total Value of Canadian Production per Employed Worker in Agriculture and in Nonagriculture for Selected Years, 1935-55

	Production Per Employed Worker					
Year	Agriculture		Non-ag	griculture		
	1949 Dollars	Per cent of 1935	1949 Dollars	Per cent of 1935		
1935	372	100	1458	100		
1940	533	143	1754	120		
1945	546	147	2210	152		
1950	646	174	1754	120		
1955	907	244	2273	156		

Sources: National Accounts, Income and Expenditure, Dominion Bureau of Statistics Canadian Statistical Review, Dominion Bureau of Statistics, Supplement 1957. Prices and Price Indexes, Dominion Bureau of Statistics. Canadian Year Books, Dominion Bureau of Statistics. Censi of Canada.

correction for these inherent weaknesses should be made in the indices used. The extent of these corrections is a subjective evaluation that varies from individual to individual depending to a large extent on his judgement and experience. Any corrections suggested in the following argument are to be judged in the above context.

Labor productivity increased about 150 per cent in agriculture and only slightly more than 50 per cent in nonagriculture since 1935 (Table 1. This suggests that technology changed more with respect to labor in agriculture than in nonagriculture during this period. Agricultural productivity is still less than one-half that of non-agricultural productivity.

Per capita production in agriculture changed very little since the thirties; if any change is evident, a slight rise is indicated (Table 2). Per capita production in nonagriculture increased about 50 per cent during this period of time.

In terms of the model the data in Tables 1 and 2 present some evidence

Table 2. Per Capita Gross Domestic Product in Agriculture and in Non-Agriculture, Canada, Selected Years, 1930–55

	Per Capita Gross Domestic Product					
Year Agri		ulture	Nonagriculture			
	1935–39 Dollars	Per cent of 1930	1935-39 Dollars	Per cent of 1930		
1930	51	100	414	100		
1935	44	86	333	80		
1940	63	123	438	106		
1945	58	114	605	146		
1950	58	104	509	123		
1955	52	102	653	158		

Sources: Ibid., Table 1.

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that during the last 25 years (1) "a," the nonagricultural production coefficient is large relative to the agricultural coefficient "b" and (2) both "a" and "b" increased in absolute terms.

Retail prices are more relevant to the postulated model than are whole-sale or farm prices. The retail prices of agricultural commodities increased relative to the retail prices of nonagricultural commodities from the midtwenties to the present time (Fig. 4). This indicates that the nonagricultural production coefficient "a" increased relative to the agricultural coefficient "b," assuming of course that the preference surface did not change over this time period.

Over the time period studied the ratio of nonagricultural production to agricultural production tended to increase (Table 3). There is no trend indicated in the ratio of nonagricultural to agricultural wholesale prices. It is significant that in each period except the last period studied that these two ratios moved in opposite directions, i.e. as nonagricultural production increased relative to agricultural production, nonagricultural wholesale prices declined relative to agricultural wholesale prices.

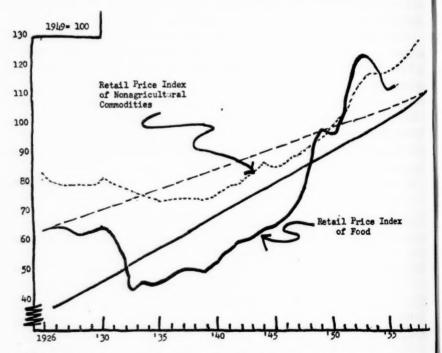


Fig. 4. Retail price indices and trends for food and nonagricultural commodities, Canada, 1926-56

Source: Prices and Price Indexes, Dominion Bureau of Statistics.

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TABLE S. RATIO OF PER CAPITA NONAGRICULTURAL GNP TO PER CAPITA AGRICULTURAL GNP AND RATIO OF WHOLESALE PRICE INDICES OF NONAGRICULTURAL PRODUCTS
TO AGRICULTURAL PRODUCTS, CANADA, SELECTED YEARS, 1930-55

Year	Nonagricultural GNP  ÷ agricultural GNP	Period to period change	Nonagricultural prices	Period to period change
1930	8.04	-0.46	0.94	+0.12
1935	7.58	-0.68	1.06	+0.06
1940	6.90	+3.57	1.12	-0.33
1945	10.47	-0.84	0.79	+0.10
1950	9.63	+2.99	0.89	+0.14
1955	12.62		1.03	

Sources: Ibid., Table 1.

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### Limitations of the Data and the Model

Technology is dynamic, at least in our western society. The effects of technological change are masked by other effects in a complex economy. No doubt consumer preference shifts occur over time. The data presented can at best indicate the probable trends of the impact of technology on prices suggested by the model quite inadequately.

Most individuals would probably agree that in the development of our western society from a subsistence to a highly developed economy, technological change has been more rapid and far-reaching in the non-agricultural than in the agricultural sector. In a subsistence economy the agricultural production coefficient "b" would be large relative to the

nonagricultural coefficient "a," i.e. the ratio  $\frac{b}{a} > 1$ ; in a highly developed

economy one would expect the ratio  $\frac{b}{a}$  < 1. Therefore, during the process

of development through technological change one would expect agricultural prices to rise relative to nonagricultural prices. Because it is seemingly impossible to hold the units of measurement to which our production and price indices refer constant over time, it is difficult to present evidence to substantiate the implications of the model. However, it can be argued with some justification that the nonagricultural unit of measurement has expanded more due to quality and variety of commodities and services than has the agricultural unit of measurement. If this be true, then the prices of agricultural products would, on a constant per unit basis, show a much larger rise relative to nonagricultural products over time than is indicated by our ordinary sources of data.

In assessing the relevance of the data to the model one must consider the effects of changing consumer preferences. If consumer preferences change in favor of nonagricultural commodities, then the prices of agricultural commodities fall relative to nonagricultural commodities with no change in production possibilities. With respect to prices, a consumer preference change may either offset or complement a technological change. These two types of change are not independent but the possibility that consumer preferences (1) lag technological changes and (2) move in the same direction as technological changes, requires some consideration.

The assumption of a closed economy is implicit throughout this discussion. No attempt is made to analyze the modifications international trade would impose on the model. Therefore, this discussion is more appropriately considered in the context of a closed or world economy.

The above discussion of limitations is not complete by any criterion but it does single out some of the important difficulties in assessing the analysis.

## Conclusions Re Technological Change and Agricultural Prices

(1) During the last two decades the rate of technological change in agriculture has probably been higher relative to the rate of technological change in nonagriculture than at any time in our history. Consequently, the long-term rate of rise of agricultural prices to nonagricultural prices was significantly reduced during this period.

(2) As the economy develops and expands, changes in technology will

be less evident in changing price relationships.

(3) Over the long term technological change will probably occur at a faster rate in the nonagricultural than in the agricultural sector; consequently, over the long term, agricultural prices will rise relative to nonagricultural prices. However, the relative rise of agricultural prices may be damped by the shifting of consumer preferences toward nonagricultural commodities and services, particularly after an "adequate" diet level is reached.

(4) Some of the literature and comments on technology in agriculture imply that we are only on the threshold of technological possibilities. If the rate of technological advance is faster in agriculture than in nonagriculture in the immediate future (two to three decades), then we are going to be faced with, (1) a period of declining relative prices in agriculture, and (2) a rapid shift of resources from the agricultural to the nonagricultural sector in order to reach an equilibrium position in production and consumption.

### Remarks and Observations Regarding the Effects of Technological Change for Incomes in Agriculture

Price is one factor in income determination in our capitalistic economy of the western world. Price plays a less dominant role in income determinat chang portai relativ for th and r chang

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mination as more steps are taken toward a welfare state. Institutional changes, e.g. income tax and transfer payments, hold a relatively important place in determining income. While it may be safe to assume that relatively free markets will play the dominant role in price determination for the forseeable future, one would hesitate to predict the institutional and policy changes that might occur over this time period that would change the income distribution pattern.

One does not question that technological change increases the net economic potential of society, but some sections of society may be adversely affected because of various rigidities in our economic system. One must show some caution in comparing relative and absolute income positions of sectors of society. Absolute gains in income are probably more pertinent than relative gains as far as assessing the change in economic well-being of a segment of society. A relative gain in income is neither sufficient nor necessary for an absolute gain in real income.

During the last two and one-half decades, a period of great technological change both in agriculture and in nonagriculture, the absolute income of both sectors has been rising. However, agricultural income has been considerably below nonagricultural income. From 1936 to 1956 agricultural income has varied between a low of 20 per cent and a high of 75 per cent of nonagricultural income (Fig. 5). Over this time period, agricultural income has tended to increase relative to nonagricultural income at a rate of about 2 per cent per year. Because of the high degree of variability in agricultural income relative to nonagricultural income one would be on hazardous ground in extrapolating this trend.

One of the more comprehensive studies of the relative incomes of agriculture and nonagriculture indicates that it is almost universally true that agricultural income is low relative to nonagricultural income.<sup>3</sup> In addition this study indicates extreme variability in this income ratio among periods within regions within countries, among regions within countries and among countries.

The following table is taken directly from the above-mentioned study. It is indicated in this study that in some countries this incentive income ratio is quite stable over long periods of time. It is interesting to note that with respect to the incentive income ratio the United States, a country with one of the highest incomes in agriculture, ranks fourth while China, with a very low income in agriculture, falls in the first category. American agriculture is in a low relative income position probably due to the fact that nonagriculture is in a very high income position. The major purpose of this table is to indicate that the relative income ratio is,

<sup>&</sup>lt;sup>3</sup> J. R. Bellerby, Agriculture and Industry Relative Income, London: MacMillan & Co. Ltd., 1956.

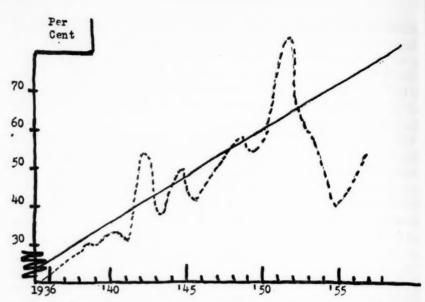


Fig. 5. Per capita agricultural income as a percentage of per capita non-agricultural income (1935-39 dollars), Canada, 1936-55.

Sources: National Accounts, Income and Expenditure, Dominion Bureau of Statistics. Canadian Statistical Review, Dominion Bureau of Statistics, Supplement 1957. Prices and Price Indexes, Dominion Bureau of Statistics. Canada Year Books, Dominion Bureau of Statistics.

in many respects, quite inadequate in assessing actual income levels.

On the basis of the somewhat meager evidence presented, the following are the conclusions regarding the impact of technological change for agricultural incomes.

(1) Agricultural economic incomes will remain low relative to nonagricultural economic incomes.

Table 4. Classification of Countries According to Probable Real Incentive Income Ratio, 1938<sup>3</sup>

- Ratio probably over 75 per cent: Australia, New Zealand, France, China.
- 60-75 per cent: United Kingdom, Denmark, Germany, (India, Burma, Hungary).
- Between 45 and 60 per cent: Sweden, Canada, Finland, Italy, (Chile, Japan).
- 4. 35-45 percent: United States, Netherlands, Eire, Peru, (Norway, Bulgaria, Portugal).
- Under 35 per cent: Egypt, Mexico, Phillippines, Thailand, (Turkey).

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(2) Assuming full employment of resources, technological advance will improve the absolute income potential for agriculture and as the necessary adjustments are made, agricultural incomes will rise absolutely; it is likely that agricultural incomes will also rise relatively if the assumption of full employment of resources holds.

(3) Any action that can be taken to assist agriculture in the necessary adjustments it must make to technological advance in either the agricultural or nonagricultural sector, will improve the general or average income

position of those engaged in agriculture.

# DISCUSSION: IMPLICATIONS OF CHANGING TECHNOLOGY FOR PRICES AND INCOMES IN AGRICULTURE

G. E. Brandow Pennsylvania State University

MacGregor's model is a good one for showing in a very broad way the implications of advancing technology for resource use in agriculture and industry and for terms of trade between the two sectors. But I have two

general objections to the model.

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The first is regarding the way in which the exact forms of the functions have been specified. The indifference map is represented by a set of rectangular hyperbolas, and these imply that the income elasticity of demand for both farm and nonfarm products is unity. A great mass of empirical evidence shows that the income elasticity of demand for farm products<sup>1</sup> is distinctly less than unity and probably diminishes as income rises. The indifference map would better represent the facts if the curves converged toward a point off the lower right-hand corner of the diagram and if the higher-preference curves were rather sharply bent. It would then be seen that equal proportionate changes in technology in the two sectors require a shift of resources from farm to industry.<sup>2</sup> Farm prices must decline in relation to nonfarm prices to bring this about. It would also be seen that an excess of farm production can lead to extremely unfavorable price relationships for farmers in a high-income economy (the slope of the indifference curve where it passes through the point representing the farm, nonfarm output combination may be very steep).

My second objection to the model has been anticipated but is nonetheless important. When one undertakes a close study of the impact of technology on agriculture, he needs a much more complete set of variables

<sup>2</sup> Complicating questions arising from population growth are ignored.

<sup>&</sup>lt;sup>1</sup>As they leave the farm. Income elasticity for marketing services is higher than that for raw foods and fibers.

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and greater ability to handle dynamic problems than the model provides, I have such points as these in mind:

1. The method of comparative statics almost inevitably treats the problem as an episodic rather than a continuing one. But technological advance in farming has been persistently ahead of resource adjustment required by rising efficiency. The means by which adjustment occurs and the obstacles to it are fundamental to resource allocation and income distribution in a developing economy; they should be highlighted rather than obscured.

2. How the fruits of economic efficiency in any sector of the economy are shared depends in part on the competitive situations in the sectors. This, too, may be a particularly important consideration in a rapidly changing economy.

3. The "farm problem," as the term is loosely employed, usually relates to farm families' income, much of which is a return on family labor. Technology often leads to substitution of capital for labor, and changes in the farm labor force are much different than changes in total farm resources. The model should permit the labor factor, at least, to be studied separately.

4. Technology often leads to more efficient utilization of farm products and to the development of synthetic substitutes. Though there are high hopes that utilization research can broaden markets for farm products, the application of science in this area may continue to have the net effect of reducing the demand for agricultural resources. This is one of several respects in which the model's failure to distinguish between farm production on the one hand and marketing and processing on the other limits its applicability.

5. Individual farm and farming areas differ greatly because of unequal distribution of resources and dissimilar shifts in supply and demand for the commodities in which they specialize. Differences within agriculture are closely bound up with the impact of technology but cannot be studied if agriculture is treated as a homogeneous unit.

As the foregoing remarks suggest, I think MacGregor has understated the vulnerability of agricultural prices and incomes to technological advance, especially in a high-level economy. Over-all efficiency in the use of farm resources needs to increase only a little faster than the growth of population to require a transfer of resources from agriculture to industry. Agriculture experiences a fairly rapid natural increase in the labor supply, but technology is likely to reduce farm labor requirements even when total resource needs in agriculture are rising. In a way never very satisfactorily analyzed, the competitive structure in much of industry—including labor—may enable the nonfarm sector to retain more of the benefits

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of its own gains in efficiency than farming typically does. Imbalance between incomes in the two sectors is not temporary; it is typical of a progressive economy, as the Bellerby data suggest, and I doubt that a marked improvement can be expected soon.

All of this may make technological advance sound like a horrible thing. But clearly the application of science to production of goods and services has been the great means by which the level of living has been raised, the drudgery of human toil reduced, and, I would contend, the cultural richness of life for the great mass of people enhanced. Agriculture has shared in this, as a comparison of United States or Canadian farm life with Asian peasantry dramatically shows. The nature of human wants and the basic labor-economizing character of technological advance probably require some lag of agricultural labor earnings as the process unfolds and as resources are shifted. The lag and abrupt changes in it indeed create some of the important social problems of our day. It would be sensible national policy to mitigate the pains of progress, whether they arise in agriculture or elsewhere; but this needs to be done with an awareness that continued technological progress throughout the economy is essential to western society.

### EFFECTS OF SCIENTIFIC PROGRESS ON THE FAMILY FARM

Chairman: C. C. Spence, Canada Department of Agriculture

# TECHNOLOGICAL ADVANCE AND THE FUTURE OF THE FAMILY FARM

JOHN M. BREWSTER<sup>1</sup>
Agricultural Research Service, USDA

In TWO respects, the family farm is unique. Its operations are often as highly mechanized as those of auto and steel manufacture where family units of production are unthinkable. And, since colonial times it has frequently been accorded a singular cultural role in the life of the nation. These are uncommon distinctions, meriting attention of students of American life. In considering its future, our interest centers on both the cultural and economic roles of the family farm because judgment of either role is affected by merits or demerits in the other.

Our concept of the family farm is equivalent in meaning to a family unit of production, whether in agriculture or industry. Such a unit is characterized by the fact that, except for high seasonal labor peaks, most of the functions of labor and management are combined in the same individual or family. Thus conceived the family farm includes the identity of household and firm, but it need not be the place of family residence.

The family farm has played a unique belief-forming role in the life of the nation. Of all our institutions, it most conserves the particular modes of conformity with the Work-Imperative as received from the first generations of the Protestant era. The heart of this imperative is the judgment that one fails in his duty to do the best he can by himself, his family, his country, and even all men if he buys the "easy ways" at the expense of his workmanlike excellence in any socially useful employment of his choice.

Analysis leads to four conclusions: (1) Certain value judgments indigenous to the family farm rendered rather easy the transition from feudalism to democracy under agrarian conditions. (2) Other value judgments equally indigenous to the family farm imperil its future because they are widely regarded as drags on social advance in the "machine age." (3) In the two-century conquest of the virgin continent, the family farm, with its underlying Work-Imperative, germinated a unique agrarianism that included the American dream. A central feature of this agrarianism is the judgment that the proper test of deserved esteem and acceptance of any

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<sup>&</sup>lt;sup>1</sup> The opinions expressed in this paper are those of the author, and do not necessarily represent the views of the Farm Economics Research Division, Agricultural Research Service or the USDA.

institution is superior proficiency in performing its social function such as feeding and clothing the nation or rearing a family. It is questionable if any institution has fostered this ideal of merit more than the family farm, or is more subject to its peril. Consequently, I am unable to see how the family farm could survive the perils of its traditional ethic, should it show any appreciable inability to keep in step with technological advance.<sup>2</sup> (4) Even after taking due account of current scares over "vertical integration" and other matters, I find no convincing evidence that the outlook is dismal, although a sharp reduction in number of farms is foreseeable.

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In developing these conclusions, a useful point of departure is the observation that before the Reformation all classes, nobility and serfs alike, shared a deep aversion to work beyond the amount required to support one's customary mode of life. This was not because people were lazy; they could think of no reason, except greed and miserliness, why anyone should forego leisure and consumption for the sake of doing more work than needed to meet his customary needs.<sup>3</sup> The one exception was the monasteries where men viewed themselves as exemplary doers of God's work. They viewed this work as a highly specialized occupation designed to enable one to utilize his whole energies in an unremitting expression of gratitude for God's infinite love and gift of eternal life. For accomplishment of this purpose, they at length organized the entire 24-hour day into a series of professional routines<sup>4</sup> that were known as the Holy Callings. Thus the Work-Imperative was first incubated in the monasteries.

Zeal for infusing all human activities with a God-seeking spirit, led Protestant founders to shift the Work-Imperative from Holy Callings to secular employments, saying that all occupations are equivalent opportunities for systematic expression of gratitude for God's goodness.<sup>5</sup> This concept enabled men to enter their shops and fields, not as those driven by economic necessity, but with the enthusiasm of those who have newly

<sup>&</sup>lt;sup>2</sup> "Technological advance" signifies innovations increasing productivity of resources in one or more of the ways described by Oscar Lange, "A Note on Innovations," Review of Economic Statistics, Vol. XXIV, 1943, pp. 19-25.

<sup>&</sup>lt;sup>a</sup> Plato's analysis of the "oligarchial man" is an excellent illustration of this view-point. "The Republic," Jowett Translation, Modern Library edition, New York, particularly pp. 305-310.

The Benedictine Rules are an excellent example.

<sup>&</sup>lt;sup>5</sup> The definitive work on this subject is Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, London: George Allen and Unvin Ltd., Museum St., 1930, especially pp. 47-78, 159-183. But in identifying "Christian Asceticism" as the source of the Work-Imperative, Weber failed to communicate its spirit. To modern ears "asceticism" signifies desire for self-punishment—sacrifice for its own sake—whereas it is well known that the Work-Imperative actually originated from the religious desire for a methodical way of expressing gratitude for God's goodness.

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learned to view the fruits of their industry as the mirror of deep-felt thanks for gifts they can never repay.<sup>6</sup>

This shift in the locus of the Work-Imperative expanded religious and moral aspirations to include the conquest of nature. For the transformation of materials and physical forces into tangible goods is relatively absent from the religious professions whereas it is the dominant feature of ordinary occupations like farming. Therefore, as long as the religious injunction to work beyond the requirements of customary needs was restricted to the Holy Callings, the work process was envisioned as primarily an inward struggle of the God-seeking man against his inclinations for needless leisure and consumption. This vision of work was not lost in the transfer of the older religious work injunction to all occupations; it was expanded to include the outward struggle of man against the resistance of nature to becoming the servant of human needs. As this happened, vast energies that hitherto found release in building great cathedrals now found new expressions of their heavenward urge in sailing the seven seas, turning deserts into gardens, conquering pests and disease, breeding scrub stock into fine herds, and transforming hovels into firesides of good cheer. These were new songs of salvation. The older religious impulse for a more equitable "distribution of poverty" was expanded into a drive to increase wealth per capita. In this fashion, the Protestant founders unleashed a new conscience on the world—the judgment that anyone who places love of the easy ways above the love of excellence in any occupation of his choice fails to deserve respect of himself, family, country, all men, and even God. With the rise of this judgment, unlimited productive effort ceased to be inhibited as the expression of avarice and became prized as the proper way of meriting ever greater approbation in one's own eyes and the eyes of others. Production without limit was thus made the handmaiden of the insatiable status aspiration. This precluded any conceptual limits on productive effort as long as human wants exceed the means of gratification.

<sup>&</sup>lt;sup>6</sup> Typical of this new spirit is Richard Steel: "How stand ye idle all day . . . Your trade is your proper province . . . Your own vineyard you should keep . . . Your fancies, your understanding, your memories are all laid out therein." Cited by R. H. Tawney, Religion and the Rise of Capitalism, New York: Harcourt, Brace, and Co, 1926, p. 245. Also Cotton Mather: "God sent you not into this world as unto a Playhouse, but a Workhouse." Sebastian De Grazia, The Political Community, Chicago: University of Chicago Press, 1948, p. 61. And Carlyle: "Producel Producel Were it but the pitifullest infinite small fraction of a product, produce it in God's name! 'Tis the utmost thou hast in thee; Out with it then. Up, Up! Whatsoever thy hand findeth to do, do it with thy whole might. Work while it is called to-day, for the Night cometh wherein no man can work . . . Our works are the mirror wherein the spirit first sees its natural lineaments." Sartor Resartus, Book II, Chapters 7 and 9

<sup>&</sup>lt;sup>7</sup> For a vivid account of this new activism in America, see Alexis DeTocqueville Democracy in America, New York: Century Co., 1898, Vol. II, pp. 163-4. Also Sebastian De Grazia, The Political Community, pp. 59-71.

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Eventually, this led to the concept of the economic man whose wants are never satiated.

This new conscience of the Work-Imperative clashed with the age-old feudal division of labor. In feudal Europe, out of which America developed, the managerial and labor functions were distinctly segregated. The managerial function was esteemed as divine-like because people thought of it as the capacity to know and administer justice. The labor function depended on judgment outside itself for its aims and procedures, and people that worked were considered failures because they were thought to be essentially personifications of a servile function. The successful were deemed to be those who lived without work because they were viewed mainly as personifications of divine-like managerial wisdom and power. They were known as lords. The character ideal was the self-sufficient man, who like a god, is beholden to none because he contains within himself all the capabilities to which he owes his high station.8 In keeping with the ideal of personal independence and power of the managerial lords they shunned commerce, sharing Jefferson's belief that because trade involves dependence on "the caprice of customers," it "begets subservience and venality" which in turn "suffocates the germ of virtue. . . . " Everyone coveted the dignity, the approbation, and esteem which the ages had posited in the lords of the land.

By thus limiting these treasures to those who lived without work, the feudal segregation of the managerial and labor roles into lords and serfs blocked the new conscience of the Work-Imperative. Conceptually, this conflict was easily resolved by imaginatively slipping both roles inside the same skin. This enabled people to think of each other as "equally kings." Called the "State of Naure" by the philosophers of Europe, 10 this new equalitarian vision found unusual fulfillment in the system of family farms that emerged as the expansion of the Old World into the New pushed past the outposts of the Atlantic seaboard. By combining in the same individual (or family) the hitherto separate managerial and labor roles of lord and serf, the rise of this new institution on the moving frontier of America facilitated a remarkable character transformation. It enabled the age-old "inferior classes" to be "born again," as it were. 11 Their newly acquired managerial role endowed each with the high sense of personal dignity and independence which their feudal heritage had confined to the few who lived without work. It was as if only yesterday each in looking

<sup>\*</sup>There is thus no substantive difference between the Self-Sufficient Man Ideal of the feudal lord and the Self-Made Man Ideal of America.

Notes on the State of Virginia, 1782, Querry XIV.
 John Locke, Of Civil Government, Book II, Chapter II.

<sup>&</sup>quot;The spirit of this "rebirth" is ably captured by J. H. St. John de Grevecoeur, Letters From An American Farmer, first published in London in 1782, now available in Everyman's Library (No. 640), pp. 39-40, 41-42, 55-56, 58-60.

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at himself and his fellow workers, saw only serfs, but today beholds each as "equally a king," feeling that theirs is now the duty of building "a new heaven and a new earth" befitting the status of proud possessors of the finest treasures of the human spirit.

Any social order except democracy became unthinkable. For essential to those who view each other as equally kings are the two central value judg. ments of the democratic creed: (1) All men are of equal dignity and worth; and (2) none, however wise or good, is good or wise enough to have dictatorial power over any other. At issue was not whether political sovereignty should be the exclusive prerogative of "lords" but whether "working lords" were as deserving of political power as lords that lived without work. What symbols should be accepted as proof of highest merit-calloused hands or silver buckles? That, and all it implied, was the burning concern. With their heritage of the Work-Imperative, the working lords could look upon their labor role as irrefutable proof of their moral and civic superiority over lords that lived without work. This proof strengthened their legs so that they could stand up against the last vestiges of feudalism and demand a government that recognized humble origins and back-breaking toil as indices of highest merit. The presidential campaign of 1840 marked the high point of this battle of symbols. In that year the aristocratic Whigs concluded that they could win another national election only by throwing off their broadcloth in favor of log cabins and hard cider so convincingly as to hang the onus of aristocracy on the Jacksonian democrats.12

It is a dramatic scene—this expanding system of family farms combining into individuals the separate roles of lords and serfs in Europe, thereby implanting in the common people of America an unconquerable passion for social and political equality in spite of their inherited feudal tendency to ascribe unequal dignity and worth to the managerial and labor roles in life. This system of farms rendered the philosopher largely unnecessary as an instrument of the democratic advance in America, whereas the reverse was true of Europe. In both America and Europe people could not make the break from feudal ways of thought and practice without picturing themselves as "equally kings." In Europe, the philosopher's construct of this, called "The State of Naure" enabled people to get this picture only indirectly. In America, an expanding system of family farms gave them the same picture much more vividly by making each a "lord." As a consequence, most Americans have tended to be suspicious of philosophers, feeling that on the big questions the simple maxims of com-

<sup>22</sup> Arthur M. Schlessinger, Jr., The Age of Jackson, Boston: Little, Brown and Company, 1945, pp. 289-293.

<sup>&</sup>lt;sup>13</sup> In this connection see De Tocqueville, *Democracy in America*, Vol. II, pp. 2-3. Also james Bryce, *The American Commonwealth*, New York: Macmillan and Co, and London, 1895, Vol. II, pp. 760-763.

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mon sense are more trustworthy than philosophic disquisitions. Jefferson never spoke more truly than when he said that in composing the Declaration, he was merely voicing "the American mind," aiming at neither "originality of principle or sentiment." America's comprehension of the democratic creed has never stemmed from reflections on the nature of man abstracted from any and all specific social roles, so characteristic of the philosophers of the French Enlightenment. On the contrary, democratic language and passion for social and political equality evolved mainly through the fact that at an early date in our history an expanding system of family production units endowed most people with a common managerial role that enabled them to see and affirm in each a nobility and dignity that their immediate past had reserved for royal blood.

This bridge from feudal to democratic thought and practice long fostered a belief in the superiority of farmers to urban workers with respect to capacity for responsible citizenship—the use of political power for establishing equitable laws for all concerned. This belief crops up in the saying that "farmers are the backbone of democracy" or that they are the "balance wheel of society." Such sayings are in fact but lingering echoes of the backbone of feudal thought-the judgment that civic capacity is identical with capacity for managerial roles. Slipping inside the skins of the lower classes a managerial role transformed the feudal identity of managerial and civic capacities into a demand for popular sovereignty-a demand for government from the bottom up instead of from the top down. Thus America actually became a democracy before she was able to rid her mind of the older identity of managerial and civic capacities. In desiring free government for all posterity, such a mind is unnerved by the prospect of an industrial society that splits the managerial and labor functions into separate classes. By and large, this was the mind of premachine America.<sup>16</sup> As America advanced into the "machine age," the farmer was envisioned as the personification of sound principles, whereas, by comparison, the wage role was substantially that of home-bred aliens. Distasteful to an ever growing labor population struggling for status under an industrial regime, this distinction has tended to alienate their good will toward agriculture, thereby endangering the future of the family farm.

<sup>&</sup>lt;sup>14</sup> Saul K. Padover, *Jefferson*, New York: Harcourt Brace & Co., 1942, p. 54.
<sup>15</sup> For example, see Rousseau, "Social Contract and Discourses," Everyman's Library,

especially pp. 13-19, 174-177, 184-186, 196-199, 249-271.

At the Constitutional Convention Madison bluntly stated: "In future times a great majority of the people will not only be without land and other sort of property. These will either combine under the influence of their common situation; in which case the right of property and the public liberty, will not be secure in their hands: or what is more probable, they will become the tools of opulence and ambition, in which case there will be equal danger from the other side." (Documents Illustrative of the Formation of the Union, Govt. Printing Office, Washington, D.C., 1927, pp. 489-

#### II

While the family farm fostered certain judgments of value that greatly facilitated the shift from feudalism to political democracy, it also cradled three further value judgments that long retarded desirable social change under corporate industry of the machine age. These are: (1) Proprietors or their legal agents, deserve the exclusive right (power) to prescribe the rules and procedures for operating their production units. (2) The individual (or family) alone is and ought to be wholly responsible for his own economic security throughout life. Therefore (3) the primary function of governments is (a) to prevent encroachment on the "natural" right of proprietors to run their production units as they see fit, and (b) to prevent the imprudent from pressing either government or business into assuming the burden of their economic security. The politico-economic mind constituted by these judgments is as indigenous to the family farm as its cover of grass and flowers. These judgments are an indispensable guide to ways of maintaining freedom and personal responsibility in an economy of family production units where households and firms are identical Under these conditions, the individual's thrift and industry take the form of land and capital accumulations with which he works; firms become extensions of the personalities of proprietors; hence to interfere with proprietary power to run production units as one pleases is to rob proprietors of the right to be free. Moreover, the same thrift and industry which provide the individual an opportunity for increasingly productive employment also provide him economic security in later life; therefore, the chances are that if he winds up without such security, it is merely evidence of a misspent life-habitual distaste for the Work-Imperative.

As machine industry began resegregating the managerial and labor functions and recombining them in thousands of new ways, the more ambitious and talented sons of the family farm and the small town moved to the higher levels of the industrial hierarchy, the press, the university, the pulpit, and all media of communication, carrying with them their heritage of rural judgments concerning unfettered prerogatives of proprietors and total responsibility of the individual for his economic security. In no small measure, our modern industries were founded by lads from the field, such as the McCormicks, the Deerings and the Armours. It is not wide of the mark to say that the typical "captain of industry" was simply a farm boy a long way from home.

Thus the belief-forming role of the family farm must be assessed from the standpoint of its impact upon the formation of the "machine age" as well as the earlier formation of the republic. From a political standpoint America is principally indebted to the family farm for the fact that, while she is the youngest of the great powers, she is the oldest of the democ racie prince of the cell street posses one's and from

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racies. But from an economic standpoint it is equally evident that she is principally indebted to this institution for the fact that she was the last of the Western nations, great or small, to make any appreciable move in the direction of so-called social legislation. For not until the 1930's was the dominion of essentially rural judgments over the industrial and political structure of the nation replaced by the modern judgment (1) that the power to prescribe the working rules of production units is the joint possession of all parties involved in firms and (2) that responsibility for one's economic security is a joint obligation of the individual, business and government. With dislodgement of the older rural value judgments from urban leadership, the family farm tends to be associated in urban thought with a politico-economic mind that impedes achievement of maximum freedom and responsibility attainable under the modern regime of corporate management. Experience of farmers during the last 25 years with burdensome surpluses, and their plea for government assistance, may have modified older politico-economic attitudes. It is questionable, however, if such change has been sufficiently recognized to retrieve lost prestige.

#### III

The danger of the family farm becoming the victim of its own ideals of merit unfolds from the vantage point of the two-century assault on a virgin continent by wave upon wave of individual families.<sup>17</sup> Conquest of the wilderness stemmed from many motives but the ones most relevant to our problem are those of the Work-Imperative. Implicit in this imperative was, and in some measure still is, the belief that in their workmanlike capacities even the humblest men possess ample means for closing the gap between their present circumstance and their aspirations. This faith completely transformed the symbolic character of the wild continent. To the native Indian it was an eternal assurance of his leisurely mode of life. To intruding enterprises, seeking a workbench on which to prove themselves, it was in an almost literal sense "the substance of things hoped for, the evidence of things unseen." Their romantic imagination at length invested the whole wide wilderness, canopied under the vaulting heavens, not with Wordsworth's "still sad music of humanity," but with the Creator's joyous promise sought through ages past by the downtrodden and oppressed of all the earth. In this way there emerged the inspiring vision of a formidable continent transforming into farms and homes and thriving cities in response to diligence, thrift, and industry. In larger compass this moving

<sup>&</sup>lt;sup>37</sup> "In the main, the great West was conquered by individuals, or to speak more accurately, by families." Charles A. Beard and Mary R. Beard, *The Rise of American Civilization*, New York: Macmillan Company, 1930, p. 509.

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vision included an economic dream of plenty, awaiting only a little time for diligent industry to yield its bounty; a political dream of good government, awaiting only a little time for plain people to make their voice and commonsense heeded by the rich and powerful; and finally, the feeling that America was destined to play an auspicious role in bringing to pass the age-old prophetic dream of a worldwide realm of law and justice. The eloquence and power of this vision lifted the hearts and strengthened the arms of all who struggled with the wilderness.

This dream is the heart of American agrarianism. This means that a distinction must be drawn between the agrarianism that is actually indigenous to American agriculture and "urban agrarianism" with its major premise that a "peculiar goodness" arises from the relationship between the soil and the man who tills it. To be sure, farmers are never offended by this doctrine, which traces back beyond Virgil and Cicero. 18 In fact, a self-indulgent pride not uncommonly induces tnem to believe it until the logician draws its policy implications. For, if the relationship between the soil and the man who tills it produces a "peculiar goodness," then sound policy requires that the state (1) severely limit the size of farms, so as to get and keep as many people in agriculture as possible, and (2) also limit "fee simple ownership" so as to make certain that they will hold onto their farms. 19 But one can no sooner draw these implications of "urban agrarianism" than the typical farmer recoils, saying in effect, "that puts "a ceiling on the American dream" which is his distinctive heritage. 20

This American dream with its underlying spirit of the Work-Imperative includes the judgment that esteem and acceptability of any institution is merited by superior proficiency in performing its social function such as feeding the nation. Thus, while great sentiment may gather about the family farm, there is no sentimentality about its test of deserts. Should technological advance appreciably outstrip its capacities to keep in step, even the most efficient family farms possible would seen be identified with wasted manpower, land, and other resources. Thus the family farm would

<sup>&</sup>lt;sup>18</sup> See for example Richard Hofstadler, The Age of Reform, New York: Alfred A. Knopf, 1955, pp. 24-27.

<sup>&</sup>lt;sup>10</sup> For instance, no one could mortgage his farm.

Two sources of this "urban agrarianism" are notable: (1) Eastern artisans of the 19th century who dreamed of Western land as a refuge from the rising factory system that they felt was crushing them. John R. Commons, Documentary History of American Industrial Society, Vol. VII, pp. 293-310, 317-320; Vol. VIII, p. 5 ff. Arthur M. Schlessinger, Jr., Age of Jackson, pp. 192-193, 344-349. Arthur Dorfman, The Economic Mind in American Civilization, New York: Viking Press, 1946, Vol. II, pp. 684-686.

<sup>(2)</sup> Devotees of the ancient aristocratic belief in this decadence of urban society as compared with rural life. For a recent example of this latter viewpoint, see Volume of Essays by Twelve Southerners, "I'll Take My Stand," New York: Harper and Brothers Publishers, 1930, especially pp. 19-20, 70, 119-120, 172.

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become the badge of waste, not only because of the alleged materialism of America but more importantly because of her potent idealism—her devotion to qualities of mind and spirit that are prized for their own sake as well as for effectiveness in producing at least cost. As a consequence, I am unable to see how the family farm could escape the doom of the very ethic it has so long and conspicuously fostered, should its maximum size and minimum managerial requirements become appreciably incompatible with technological advance, either from the side of farm production or the side of farm marketing.

#### IV

In evaluating the imminence of this peril, it is recognized that technological advance requires an increasingly higher degree of managerial ability, but the sometimes ventured assumption that there are not enough farmers with sufficient managerial ability to keep step with technological advance is not entirely accepted. If larger than family farms took over in most sections of the country, the relative prices of farm products would have to be high enough to return to all production factors rates of pay equal to those which they can earn in other employments. Otherwise, factor owners would shift their services to nonfarm jobs. In contrast, family farmers, for the sake of noneconomic goals such as being selfbossed, have long shown the ability and willingness to meet the nation's food and fibre requirements at prices lower than those needed to return to their labor and capital as much as these services can earn elsewhere. Were this not the case, larger than family farms might have long since driven family units to the wall. As matters stand, however, studies by Glenn Johnson and his students have shown that it is virtually impossible to design any form of dairy organization in the Detroit milk shed that would enable larger than family farms to drive out the most efficiently designed family farms.<sup>21</sup> There is no reason for assuming a demand price situation more favorable to larger than family-size farms within the next

With these presuppositions, our problem turns on three questions: (1) Is advance in farm technology likely to expand the size of efficient farms beyond the ability of the usual family to supply at least half of the farm labor requirement? (2) Is such advance likely to expand farm investment beyond the ability of families to acquire enough capital to give them major control over farm operations? (3) Is technological advance in food processing and distribution likely to wipe out the family farm by creating

<sup>&</sup>lt;sup>n</sup> Glenn L. Johnson, "Are We Headed for Corporation Farming or Farming Controlled on a Contract basis by Big Business." Presented at Farmers Week, Michigan Agricultural Experiment Station, East Lansing, Mich., January 1958.

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a marketing structure that takes over managerial control to such a point that farmers are essentially supervising landlords or piece workers on a contract basis?

Relevant to the first two questions is the fact that the family farm is holding its own quite handsomely. Disregarding boys (10-16 years old) and women, the labor force of an ordinary farm family is approximately 1.5 man-years; hence the upper size limit of family farms as previously defined, is approximately 3 man-years, excluding high seasonal labor peaks. Using this approach, McElveen calculated that larger-than-family farms accounted for only 31 per cent of the total commercial farm output in 1954 as compared with 34 per cent in 1944, and for only 26 per cent of land farmed in 1954 as against 30 per cent in 1945.22

Land and other capital in the largest family farms in the Corn Belt now represent close to a quarter of a million dollars, with \$100,000 being frequent.23 The same is approximately true of the wheat belt. The fact remains, however, that capital requirements of efficient farms have not expanded sufficiently to prevent increases in the number of full owner operators in census classes I and II farms and of part-owner operators in classes I, II, III and IV farms during the 1945-54 period. Furthermore, ownership of both land and capital is not essential to family farms because tenants, by and large, make day-to-day decisions over farm operations with little or no interference from landlords except when permanent improvements are involved. For example, the Corn Belt is commonly recognized as second to none in the dominance of family farms and yet the percentage of owner-operators in this region has been among the lowest in the nation for decades. Throughout the 1945-54 period manager farms (as distinct from tenant or owner-operator farms) declined appreciably, and there was very little increase in the percentage of "corporate" farms. I find no significant grounds for supposing that this situation will change much within the next 25 years.

Both empirical and conceptual evidence supports the view that the future of the family farm is in no way threatened by the expanding size requirements of the most complete mechanization conceivable. For the highest degree of mechanization and specialization are found on the wheat farms of the Great Plains and it is well recognized that no economies of scale are achieved through expanding such farms beyond the point where a family can do most of the work. Larger-than-family fams are least frequent in types of farming such as cash grain, where operations

<sup>&</sup>lt;sup>22</sup> Jackson V. McElveen, "Family Farms in a Changing Economy," Agricultural In-

formation Bulletin 171, USDA, Washington, D.C., 1957, pp. 49-50; 54-55.

<sup>23</sup> M. L. Mosher, "Farms are Growing Larger," Ill. Agricultural Experiment Station, "The Agricultural Experiment Station," (The Control of the Bulletin 613, table 1, p. 4. Also Earl L. Butz, "The Agricultural Dilemma," Congressional Record, May 8, 1958, p. A 4263.

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Station, " Conare most mechanized, and they are most frequent in types of farming such as vegetable production, where operations are least mechanized. For example, census economic class I cash grain farms, producing a product value of \$25,000 and over, as a rule do not exceed the size limitations of family farms, as their average labor requirement in 1954 was approximately 3 man-years. In most cases the major control over operations on such farms resides in family operators. The comparable figure for class I vegetable farms was approximately 18 man-years.<sup>24</sup>

This is precisely the result to be expected on conceptual grounds. As explained elsewhere in detail, <sup>25</sup> farm mechanization does not transmute the pre-machine sequential pattern of operations, characteristics of family production units, into the modern simultaneous pattern which characterizes the factory system. Therefore after mechanization as before, the number of concurrent activities remain as close as ever to the number of workers in an ordinary family. Hence instead of calling for elimination of the family farm, farm mechanization by greatly increasing the areas of land a man can handle per unit of time, merely calls for expansion in size of farm. This in turn calls for reduction in the total number of farms such as is now occurring, because the amount of land available for farming is now approximately fixed.

We should observe, however, that biologically determined time intervals between many livestock and poultry operations are much shorter than those between crop operations. Consequently, certain specialized livestock enterprises may be reorganized off the farm in an approximate factory pattern, as in dry-lot dairies, and some cattle feeding set-ups. Technological advances in marketing are conducive to this change. The development of the modern super markets places a high premium on product standardization. To attain product uniformity, they seek contractual arrangements with first processors calling for delivery of specified grades of food products in relatively large quantities at given times. Processors in turn may set up contractual arrangements with growers for delivery of fruits and vegetables, table eggs, poultry and meat animals of specified grade and quality. In this way, the old-fashioned "open-market" is being transformed into a contractual chain of deliveries from grower to final consumer. Such contractual arrangements contain the possibility

<sup>&</sup>lt;sup>24</sup> Jackson V. McElveen, "Agricultural Producers and Production in the United States—A General Review," Bureau of the Census, Washington, D.C. Vol. III, pt. 9, Ch. IX of special Reports, 1954 Census of Agriculture, U. S. Bureau of the Census and U.S. Agricultural Research Service, table 20, p. 31.

<sup>&</sup>lt;sup>28</sup> John M. Brewster, "The Machine Process in Agriculture and Industry," Journal of

Farm Economics, February, 1950, pp. 69-71.

\*\*George L. Mehren, "How is the Market Made in Integrated Industries," delivered to the National Institute of Animal Agriculture, Purdue University, April 21, 1958.

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that present-day independent farmers may be "forced" to so bargain away their managerial prerogatives that they will become essentially piece workers or supervising landlords, with the food processor or mixed feed dealer providing most of the management and bearing the risk of price fluctuations. Many believe that the family farm will thus be pushed out of its dominant position in agriculture.

In great measure this belief arises from the fact that much of the literature on "contract farming" treats the subject as an adjunct to "integration." Integration is defined as bringing the control of two or more stages of the farm production-marketing process under single management. Contract is then brought into the picture as one of the instruments by which integration is achieved. The literature often makes contract farming appear to mean only those agreements in which the farmer, for certain price consideration, not only consents to produce specified amounts and grades of particular products but also surrenders his managerial prerogatives. This makes him essentially a directed worker. Many believe this has happened in the "broiler industry," and that we are on the threshold of the same thing in cattle, sheep and hogs. Thus a phobia arises that the independent family farm of the corn belt and elsewhere is threatened.

This fear is mitigated, however, by a number of considerations. First, contractual arrangements need not materially shrink the farmer's managerial power. This has been true of contract production of fruits, sugar beets, and vegetables throughout the inter-Rocky Mountain states and elsewhere for years. In these instances contract farming is essentially a system of negotiated prices that shifts price risks to marketing agencies without altering other risks peculiar to farm production, thus enabling farmers to make production decisions with the foreknowledge of what prices they will receive for their output. Under this circumstance contract farming is no more incompatible with the managerial prerogatives of farmers than open market operations. We know of no reason why the same principle could not be applied to hog production as well as cattle and sheep feeding. Second, it will not be as easy for "integration" to pull these enterprises off well operated family farms with complementary enterprises as it was poultry and eggs. For producing hogs and feeding cattle are much more complicated activities than hatching chicks or raising broilers, which were formerly carried on mainly as sidelines by the housewife for pin-money. Finally even if we make the very liberal assumption that the "integrated" type of contract farming takes over as much as 80 per cent of hog, beef, lamb, poultry, and vegetable production now accounted for by family farms, this would only reduce the family farm's pargain y piece

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present share of total agricultural output from approximately 70 to roughly 55 per cent.

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In line with the Work-Imperative sentiment that superior industry is the proper test of merited esteem and social acceptance, farm people by and large have always demanded public policies with respect to the peculiar educational, credit, marketing and other agricultural needs that would give farmers the same advantages as those inherent in corporate forms of business organization. It is sometimes overlooked that the efficiency of individual firms is in great measure determined by publicly supported credit, educational, marketing and other institutions that make available to them business management services that enable them to be far more efficient than they could be otherwise.

Assuming this policy is followed in the future as in the past, our inquiry leads to these conclusions concerning the future of the family farm. (1) Only through keeping in step with technological advance can the family farm escape the peril of the ideal of merit and other politico-economic value judgments it has conspiciously fostered throughout the life of the nation. (2) Nevertheless the visible future of the family farm is not dismal. Even when we make unnecessarily liberal estimates for the growth of the "integrated" type of contract farming, our best guess is that quarter of a century hence will still find an agriculture of predominantly family farms. Technological advance is likely to result in farm enlargements to a point where the hard core of commercial agriculture consists of not more than about 1 million farms; a development which may be regarded as further evidence of the adaptability of this institution to changing conditions.

# DISCUSSION: TECHNOLOGICAL ADVANCE AND THE FUTURE OF THE FAMILY FARM

Sol. Sinclair University of Manitoba

Brewster presents a logical explanation of the forces that fostered and are supporting the family farm concept, and also a refreshing viewpoint as to the future of the family farm. Through a philosophical approach, he indicates in a persuasive manner the reasons why farmers and farm organizations are so insistent upon the maintenance of the family farm as the typical unit. The logic of his arguments and my complete innocence of any formal training in philosophy compels me to accept a great part of

what he says. In fact, when he ties the concept of the family farm in with religion, to disagree with him would be almost sinful. This agreement, however, does not preclude my making some comments which may add to his arguments or raise some questions about various points that he presents.

The family farm has been a part of our socioeconomic system, as well as a part of our culture, for centuries. For the past Brewster indicates rather clearly, that the family farm concept played a very important role both in the cultural and economic development of our society. I wish he had continued to discuss this particular feature in our current setting. In other words, I would have liked to hear Brewster's views as to the justification on whatever grounds, of the continuation of the family farm. In some European countries it is government policy to promote this type of farm unit. There it is justified on political and social grounds. In those countries the family farm is looked upon as a unit in its traditional sense; that is. smallish in size, a residence on the farm, management and labor provided by the farmer, and so forth. On this continent, I feel that we do not have any clear-cut definition of what a family farm is. Such a definition, together with reasoning as to the place and need for the family farm, would help a great deal in clearing policy regarding agriculture both at the sociological and economic levels. Since we are not given this definition or reasoning by Brewster, one may be justified in drawing certain conclusions from his comments. One, that the family farm will continue to be a dominant form of farm organization in some form or another; or two, that it is desirable to continue to talk about a family farm in terms of continuous existence in order to avoid destroying the concept that we have inherited from the past. The question one might very well ask in respect to this matter is this-is the ethic behind the Work-Imperative concept sufficient to maintain the family farm, or will it survive simply by force of the unique position of the family farm and the operation of normal economic forces? Brewster suggests that it will continue by virtue of both.

It is easy to agree with the point that in the earlier centuries, when man attempted to break away from feudalism and to assert his freedom and independence, the Work-Imperative promoted the idea of work as a virtue and management as a status-giving function. The family farm provided such an opportunity. But, was this exclusive to farming? Can we not argue that the family farm developed as a result of these concepts because farming was almost the only occupation in which man could employ himself? As domestic manufacturing appeared on the picture, did not the Work-Imperative express itself through the home industries that individuals developed at that time? In other words, the handicraft economy provided the same type of opportunity for the self-expression that Brewster suggests under the Work-Imperative ethic.

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I find it difficult to accept the idea that the family farm must continue as the dominant form of farm organization either because of the philosophical Work-Imperative concept, or because of the nature of farming itself. I base my argument first on the changing attitude of people towards the institutions of enterprise decision-making and management, and secondly, the impact of technology in all its present and especially potential developments.

Over time man developed desires for other things in addition to status as an owner and manager. These include all the material things which provide the greater comforts of living. These other things are playing an ever greater role in man's thinking. The fact that somewhat over 80 per cent of our total population falls into the employee class may be cited as partial evidence of this statement. Maybe this is a new type of feudalism from which the employee group is not too anxious to emerge. This shift to our current industrial "feudalism" can be attributed to the technological developments that took place since the industrial revolution. It seems logical, therefore, to argue that the same changes will occur in agriculture.

Brewster defines the family farm as having two essential characteristics; that is, it performs the management function and provides at least half of the labor requirements. On the basis of this definition, one cannot argue the disappearance of the family farm. By excluding the elements of residence, ownership of land and capital, and size of farm, there is no limit to what can be called the family farm unit. I fail to see, however, how this definition levels with the earlier reasoning of the growth of the family farm, and especially with the current definition of some farm organizations of the family farm. I cannot conceive of agreement by many American or Canadian farm leaders that the one million farms Brewster anticipates in the United States 25 years hence will be family farms. By excluding the elements aforementioned as requirements of a family farm, Brewster, by definition, permits technological advances to bring about integration in agriculture, greater degree of contract farming, and perhaps even more so, custom operations in agriculture. When such things occur in agriculture, as they are now beginning to, then Brewster's family farm 25 years from now will be very little different from that of a large industrial plant as we know it today. The family farm operator of 1980 may very well operate a unit which consists of a very large area, managing large capital investment not owned by him and by custom arrangement, have many workers do his work for him on his farm either directly or indirectly. Is this still a family farm in the true traditional sense?

Brewster, of course, argues also that the family farm will continue because of the nature of agriculture and the time sequential of operations in the production process. Currently, this is a valid argument. However, one must look into the future and try to visualize what technology may bring about, even on this score. Workers in the fields of plant and animal science suggest a variety of developments which, while they will not change the sequence of the growth process in plants or animals will, and even now do, shorten some of these processes. I am thinking of such things as stilbestrol and antibiotics as factors in the growth and finishing of certain livestock; also, of synthetic feeds for young pigs that reduce the total time that the piglet needs to depend on its mother. This means that the sow may produce four litters a year, perhaps, instead of two, Certain developments are also taking place in the plant science field which, no doubt, will influence plant growth. I may be accused of being starry-eyed, but on the other hand, things are moving fast in the field of science, and one should not decide now that any feature which produced a certain type of economic production unit in the past will continue to dominate the scene in the future.

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# INCREASED CAPITAL REQUIREMENTS AND THE PROBLEM OF GETTING STARTED IN FARMING

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OMPLIANCE with the program theme does not demand casting of , this topic in a pure context of scientific progress. Placing changes in farm capital requirements in a framework implying a dominant role of technical advance would furnish rather obtuse formulation of forces affecting the investment position of farming no matter how broadly the process may be construed. To an important extent the current position of farm capital requirements reflects changes of capital values, perhaps more especially land values, allied with the drift of the general price level in cyclical and trend relation from its former positions. In a less obvious and as yet inadequately-defined way it reflects the long-run progression of land values with maturing economic development and transition from a more largely rural to an intensified urban-industrial economy. Many farming areas demonstrate a strongly accentuated force of these processes translated through changes of utilization and intensity and changed aspects of land demand and supply accompanying population shifts and market change. The level and composition of farm capital investments also indicate important substitution effects in the course of secular adjustment to optimal combinations aside from those based on technical modification of substitution coefficients. A substantial element of the latter may trace more basically to the general substitution of land and capital for management and labor embodied in the process of limiting the farming operation to a smaller labor force in a typical context of a family operating unit.

In company with these factors, by far the strongest and most direct force increasing farm capital requirements has been the drive for social progress in agriculture, a desire by farming to achieve standards which retain rough comparison of trend with income advances of the nonagricultural sector. Where \$400 of net cash income to the farm family furnished an acceptable comparative standard of farm income prior to World War I, and perhaps two to three times this amount gave fair comparison in the 1920s, five to six times the figure suggests little more than minimum equivalence at the present time while 12 to 15 times might be readily entertained as a reasonable standard for the typical developed commercial farm.

The main burden of sustaining the increased income requirement has fallen to expansion of the capital scale of the farm unit. Coupled with sharp advance in income need, reliance on capital additions has injected a double disproportion into the change in capital requirements spelling out the dramatic increase in farm investment needs.

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This does not complete the factors responsible for the greatly increased investment requirements of farming. In common with other processes farm capital requirements have carried their own built-in escalators hiking still further the required investments for effective capitalization of the ordinary farm. A large farm capital implies commensurate managerial capacity to effectively accumulate and manage the capital under the difficult circum. stances presented in farming. This entails incomes which compare favorably with alternative opportunities for the managerial qualifications demanded. The large investment requirements have also forced larger savings margins (not necessarily higher ratios of saving) as a component of income needs in farming. Furthermore, large capital investments, with their elements of larger capital risk, have set up the need for larger buffers against risk in terms of capital allocations ensuring additional flexibility and asset and income reserves guaranteeing necessary liquidity, With labor returns furnishing both a less fruitful and less elastic area of income and savings than formerly, each of these has thrown additional dependence on capital scale.

There propably is little to be gained from trying to specify investment requirements for typical or particular farming situations. Suffice it to say that too many indications of needed investments still lean over backwards in conservative estimates attempting to reconcile minimum requirements with the realities of stern capital limitation. Figures in the vein of \$5,000 to \$7,000 of capital per \$1,000 of net operator income, with the income standard related to a bare minimum for family living, give little suggestion of reality compared with a range of anywhere from \$8,000 to \$20,000 of capital per \$1,000 income, with such income combining family maintenance needs and a large required savings margin, which appears to reflect more nearly the current capital needs for reasonably effective establishment and progress in farming. Too often, therefore, suggested requirements point to a snub-loop minimum which threatens a noose for an operator attempting establishment under comparatively less favorable circumstances.

Within their changing aggregates, farm capital investments have undergone equally important changes of form. The dominant aspect has undoubtedly been the growth in the non-real estate portion of capital in the average farm. Much of the change in this area is traceable more directly to forces of scientific progress bearing on farming adjustment. It is marked, on the one hand, by the large increase of equipment investments associated with changeover to motorized power and broad progress of general farm mechanization, whereby necessary equipment outlays in many cases approach and in some instances exceed the real estate investments in permanent improvements of farms in terms of modernization and expansion of buildings and facilities and various phases of basic land development

and soil amendment. It also shows up importantly in the broad expansion of production inputs, including the important fuel and equipment operating items taking the place of farm-based power, and a proliferation of production materials involving a drug store count of trade-names and extending in many instances to the annual seed and feed stocks and animal inventories of farms. In conjunction with growing specialization promoted by technical and market change, non-real estate capital, has proceeded to the point where many farms rely almost entirely on purchased production inputs to constitute secondary production processes. In these situations the non-real estate portion of capital has not only outrun, but basically overwhelms the real estate investment. This general broadening and greater diversification of farm investment should not obscure the fact that the real estate investment remains, and likely will remain, the largest and most important single item of farm capital. Until an advanced era of hydroponics releases agriculture from dependence on the physical and spatial elements of land, real estate will hold a dominant place in the capitalization demands of farming.

Less prominent but equally significant as an aspect of the changed form of farm investments has been the increased interdependence of the various capital elements. Formerly, control of a unit of real estate gave fair claim to effective establishment in farming; the necessary complement of working capital, in its more limited amount and less critical relation, could generally be garnered by some means or other in the process of establishment. Now, the one demands the other, and, of the two, effective complement of working capital has become the more crucial requirement. Access to a real estate unit furnishes the inroad but gives only nominal sanction to a farming career; survival and progress in establishment depend upon sufficient auxiliary capital to ensure compatible efficiency of

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es. underThese phases of capital change have done more than impose stepped-up requirements of initial capital and speed of capital accumulation on the individual seeking establishment in farming. They have altered the basic setting for establishment in terms of the access to farming afforded and the competitive conditions faced in consolidating establishment. They have essentially changed the basis of entry to farming. Gone, in essence, is the former wage-saving process of gaining entry to farming whereby would-be farmers could combine accumulation of experience and capital-saving in farm employment as an effective means of getting started in farming. Instead, if open at all, the more substantial opportunity for still making sufficient savings through wage-earning for a start in farming has now shifted to selective phases of urban employment. In farming, success of the wage-earning process leans heavily on assisted forms of wage

arrangements such as can be made available through the family operating complex. Outside of this context it more commonly requires alignment of wage-earning in some form of capital arrangement involving leasing, sharing or contracting wherein additional commitments and risks are accepted against the chance for above-average wage returns. In place of the oncenormal access via farm employment, farm entry has carried into diverse forms of non-farming inroads. Rather than depending on individual saving entry depends upon the ability to subscribe to an initial fund of capital and is subject to selective inroads based more largely on acquiring control of established operations.

In this transition, the family transfer process has emerged as the more important single phase of farm continuation, giving to a substantial segment of farming the aspects of a dynastic enterprise. It has not emerged cleanly in terms of the single-phase process of father-son transmission. Rather, it has broken through on the basis of large and varied family operations involving all manner of family relationships, operating associations and stages of continuity. Coupled with phases of dual-occupation and business-combination which involve the complex of family members and seasonal alternation of employment, it has injected an inordinate

complexity into the character of family-farm operatorship.

In its further phase the transition has produced an outgrowth of dualoccupation and multiple-business forms of farming activity which so far have been all too conveniently lumped in the simple classification of "part-time" farming. Representing neither homogeneous intent or basis of operation with respect to farming, they carry diverse connotations regarding their place and effect in aggregate agricultural organization. A large segment is allied directly with urban decentralization, involving small-farming supplements to urban employment and adding to the prevailing scope of semi-commercial and subsistence farms. Their nearercommercial phase, in turn, apparently includes a smaller segment representing serious use of supplementary employment or outside-business opportunities as a means of assisting eventual establishment in full-time farming. More commonly, they appear as an escape from the excessive demands of self-sustained farm establishment and constitute a more permanent phase of activity involving semi-reliance on farming and a variable force of commercial motivation.

The general change in the basis of access to farming has also given inroad to a growing scope of urban-based commercial investment in farming combining an increasingly significant segment of industrial farming operations. It is represented, on the one hand, by widely-diffused ownership of farm properties by business, professional, and wage-earning individuals, involving a general extension of proprietorship beyond more

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usual forms of accession to absentee control. On the other hand, it embodies a more recent growth of industrial integration of farming involving diverse proprietory and contractual forms of operation. While partly associated with the suburbanization process, it involves a major segment of commercially-motivated proprietorship reminiscent of the growth of commercial landlordism in post-feudal, industrial-revolution England. Far from performing the desirable functions of capital supply and management rationalization of this earlier era, it is instead injecting a disturbing element of outside competition into commercial operations. Its diverse forms of activity include the highly specialized and developed hobbyfarm; an extensive front of suburban dabbling; the more casual efforts of sidewalk and suitcase farmers leaning on other income; the creamskimming operations of individual investors seeking the investment returns, capital gains, tax benefits and other advantages of land ownership; and hard-headed business operations relying on benefits of integration and management centralization. It thus embodies elements of shielded and advantaged competition in relation to normal commercial farming, and furnishes a combination of market-scalper and labor-scab cutting into potential opportunities for full-time commercial operations. It is making it difficult to find and to build an effective commercial farming unit. In its major phase of nonoperating proprietorship it tends to favor the better-established rather than the beginning operator, thus restricting expansion opportunities and increasing further the competitive disadvantage of the less-developed farm. In this form it frequently stymies desired development processes for the establishment farm, forcing reliance on alternatives for which the beginning farm is often least well equipped. Alternately, the enforced lapse of progress results in discontinuance of farming or a shift to some form of part-time operation as the means of continuing a farming career. It may well be furnishing the main support for growth of contract farming—the beginning operator under pressure readily sells himself cheaply trying to retain his foothold in farming.

The broadest and severest effect of this invasion apparently rests in carrying land values out of manageable range for the ordinary commercial farmer and especially the beginning operator. At the same time, the outside competition to commercial farming probably involves increasingly significant pressure on farm establishment with respect to market competition. While still remaining more limited in the aggregate, it entails progressively more severe marginal competition in terms of sharing the potential commercial market. In its growing scope it is bringing the day closer when commercial farming interests, with strong justification, may seek some

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The end result of the combined changes in investment position and in

access to farming has been a drastic narrowing of entry-port to farming for the individual seeking establishment without special assistance of advantage. Requirements of initial capital and other inroads have effectively blocked attempted establishment of a substantial segment of would be farmers. At the same time, the prospective burdens and risks of consolidation have discouraged both entry into and continuance of farming in

favor of seemingly more tractable alternatives.

Perhaps even more significant as a result has been the critical survival situation created for the operator undertaking establishment with the firm purpose of completing a farming career. For such operators the larger capital requirements and tightened competition have raised and widened the traditional "hump" confronted in securing a start in farming. Greater and more complex needs of capital have put heavier pressure on the adequacy of working capital giving more precarious maintenance of essential operating efficiency. Greater reliance on depreciable elements of capital and purchased production inputs and larger claims of minimum family support have established high fixed-cost ratios and break-even points for the common establishment unit giving a more serious competitive disadvantage and higher vulnerability to establishment circumstances. Notwithstanding amelioration by institutional processes giving additional protection against various farming insecurities, establishment farming has been carried into a higher-risk context than formerly obtained

Gearing establishment to survival requires a basically stronger momentum of the initial establishment operation. In these terms it suggests an essentially altered view of the establishment process; as against more gradual staged progression, successful establishment has become more nearly a one-shot process of clearing the hurdle by reaching a near-competitive position through full-time farming or back-logging the farming

operation with some form of non-farming support.

This is not to suggest that unsupported career-farmers have not been able to gain access to farming in essentially satisfactory numbers. They have done so over the past 15 years on the basis of the more favorable farm income situation supporting farming progress. They have done so through the more widespread assists furnished by diverse establishment processes under conditions of relatively buoyant employment and fluid farming opportunities. They have done so by virtue of the wider aberations of success allied with recent establishment and they have done so through sheer sacrifice, through extraordinary personal effort.

They have, however, done so in greatly reduced numbers which may further decline with the more restrictive farm income situation. And they have done so with basically less security and less certainty of final establishment than heretofore. Without a strong force of formerly in-

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portant involuntary liquidation, recent farm establishment has been subject to a high number of casualties mainly involving voluntary discontinuance of farming in favor of prevailing nonfarming opportunities. A notable feature of western Canadian experience in this regard has been the high rate of withdrawal of comparatively better-established operators. While a number of extenuating circumstances make it more pronounced for this area than elsewhere, the situation is by no means unique and attests to the severe grind of the present establishment process and the shaky basis of new establishments. It belies accepted axioms implying once a farmer, always a farmer, or that 20 years of farming essentially confirms a farming career.

The reduced entry into and additional withdrawal from farming represent the main positive contribution of the changed establishment situation from the standpoint of desirable industry adjustment. The lower rate of farm regeneration has furnished the larger share of recent gains in aggregate agricultural efficiency. Important as this has been it may hold even greater significance in the event of a broad scale economic recession in which a closed door to establishment would prevent the back-flow and dam-up in farming which has been an important secular force in agricultural maladjustment.

Countering this essentially favorable aspect, the directions and force of the process leave great concern as to its acceptability in terms of broader and longer range considerations in farming adjustment. Aside from the fact that it may result in undue throttling of farm entry it is not furnishing the desired form of farming continuity. It is encouraging an excessive scope of part-time and indirectly supported farming and contributing to strong industry participation in farming against the desire for wide diffusion of full-time family operatorship. It is widening rather than narrowing the dispersion of farming efficiencies and providing doubtful selection of the most capable operatorship.

In the conflicting relation involved, reorientation of the establishment situation should not envisage more selective access to farming than now prevails. The aim, rather, should be a more discriminative process which retains rigidly individual access. It should allow wider opportunity for full-time farm establishment and permit a wider berth for entry by the unassisted young career-farmer as a balance against the advantages of family transfer and non-farming inroads. It should permit more advanced establishment of the beginning operator assuring progress toward more uniform efficiencies in the industry.

Establishment in the developing situation requires better-equipped operators. Along with a high level of technical competence it especially demands the managerial capabilities which will win through the difficult

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survival situation. For the beginning operator such qualifications represent almost as important a resource as the physical capital brought to farming Pre-farming training for farm and nonfarm youth looking to farming careers, and more inclusive extensive processes carrying nearer to the individual operating situation are emphasized as are the forms of advisory assistance and supervision combined with credit programs and other bases of assistance to establishment. Another concern is to find more effective forms of income generators which can be built into the starting farm. The search is for more immediately productive forms of farm development for flexible and temporary forms of extra enterprises and for desirable types of non-farming income supplements which will give added savings with out undue conflict with the longer-range development needs of the fam. The latter presumably admits various phases of part-time farming and outside-farm activities as successful aids to establishment. Preferably, however, they should assist eventual full-time establishment rather than serve as continuing props for inadequate and often mediocre farming

Without denying the need for a broad range of facilitating measures, the more basic means of assisting establishment is still that of providing more facile access to a more adequate complement of starting capital. For the family-based beginning farmer this calls for more-developed family arrangements by way of more adequate family operating agreements, broader retirement and inheritance arrangements to desired farming continuity. The aim should be earlier autonomous establishment or more broadly-based family operation as against the large, complex, father-dominated forms of many existing family operations.

For the unattached operator, and in the absence of more adequate credit arrangements, access to effective starting capital leans heavily on the leasing process. In this area the need is for readier access to available leasing operations, especially the nearer-developed, equipped farm passing through the retirement stage. More flexibile types of leasing arrangements and more closely integrated forms of credit, particularly those relating to working and production-capital supply, would put such operators on a more nearly equal footing with established operators and family-based starting operators in gaining control and making headway in such operations.

Alternative business-structures suggest essentially narrow opportunities for furnishing a more satisfactory capital-base in support of beginning farming. Apart from the family arrangement, partnership forms of faming have so far shown limited force and extension. Full-fledged cooperative farming, in turn, in the setting and against the background of North American farming, has shown little success in overcoming the force of

traditional organization and socio-personal obstacles to cooperative operation. In contrast the corporate structure affords a more individuallyoriented and impersonal business relationship admitting wider possibilities of general application. Its larger gains would flow from readier mobilization of capital for individual farming operations on the basis of more flexible and less risky investment participation. It does not appear to hold strong prospects for the more common run of farming. Rather, its flexibility and other advantages are more likely to see outlet in support of larger-scale farming organization and the more complex forms of business-combinations coming into farming. As against these broader changes of structure, establishment farming would benefit from more limited processes of equity-finance, particularly as applied to real-estate investments, which would defer or reduce the large burden of real-estate capitalization for the starting operator. The individual starting farm could also achieve important benefits from further extension of informal cooperation and formal arrangements in terms of capital sharing, returns-sharing and leasing applying to individual elements of starting capital. Recent developments in such forms as continuous equipment leasing and phases of capital provision involved in contract operations are affording generally wider scope for such activities.

The fringe-relation of most of the above forms of assists to farming establishment confirm the dominant role of credit as the central process for achieving more favorable continuity in farming. Better credit operation in this regard does not support indiscriminate credit expansion. Rather, it calls for rigorously selective and essentially discriminative credit development, carrying to preferred phases of establishment and aimed expressly at strengthening the position of beginning and establishment farming relative to established operations and outside competition.

The force of the growing scope of farm integration in modifying the establishment situation is still open to conjecture. It is difficult to rationalize views from some quarters which see virtual disappearance of basic agricultural problems in a glowing future of "agribusiness." In its still narrow applications, and with its attenuated implications, it does not yet lend conclusion of either consistent or desirable operation. It holds aspects of apparently favorable operation in the sphere of temporary capital aid and income generation of special significance for establishment farming. It suggests desirable applications in areas of agricultural production requiring a strong force of market integration. It can be more nearly condoned as an effective alternative to other assists such as credit development in areas where excessive risks impose unmanageable credit conditions. On the other hand, anticipating its application to the broader area of general farming carries a dominant suggestion of retrogression by way of sacrific-

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ing values of individual and independent proprietorship. In this relation it suggests reversion to a form of financial feudalism not unlike the landed feudalism of former times, with perhaps baser aspects of dependence than the earlier status entailed.

# DISCUSSION: INCREASED CAPITAL REQUIREMENTS AND THE PROBLEM OF GETTING STARTED IN FARMING

# TRUMAN R. NODLAND University of Minnesota

Van Vliet has given us a scholarly presentation. The title of his paper suggests a discussion concerning the actual capital needs for beginning farmers. Instead he provides us with a more general presentation relative to the problems of capital accumulation.

In interpreting Van Vliet's article the following seem to be the primary points in his presentation:

1. Capital requirements have increased greatly as a result of advances in technology and specialization.

2. Larger farm incomes are needed to pay for the greater capital investments and the higher standards of living demanded by farmers and their families.

3. The basis for entry into farming has changed to some form of leasing or profit sharing device instead of working as a hired hand until sufficient savings have been accumulated for a more direct entry. Increased attention is being given to family-farm transfers.

4. Nonfarm sources will furnish more of the investment capital used in farming including outright ownership which in turn may bring land values out of range of the average individual operator.

5. There should be elasticity of access into farming for those who have the desire and managerial capacity to farm.

6. More training will be needed by the beginning farmer of the future in order to have the necessary technical and management skills.

7. More rapid capital accumulation during the establishment period will be needed in order to reduce possibilities of failure. This involves easier access to an adequate amount of capital and more desirable family-farm transfer arrangements and leasing systems.

8. Credit based on character, capacity, and ability as a farm operator instead of collateral security will strengthen the position of beginning farmers.

Van Vliet's paper is rather all-inclusive and general. All farmers, including the well established individuals have problems relative to the

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increased capital requirements of farming. Beginning farmers have the same problems plus many others. A more concentrated discussion of the problems of the beginning farmer would have perhaps been more useful.

Anyone in close touch with prospective farm operators will find their discussions centering around the following-how can we find a farm to operate; what is the minimum amount of capital required; and what type of operating arrangement will fit my particular capital circumstance. Van Vliet deplores the importance some people place on minimum capital requirements for gaining entry into the farming profession. On the contrary this is the basic problem for all except those favored by unlimited family support. The farming lifetime of an individual is relatively shortprobably 35 to 40 years at the most. The young man who is choosing farming as a career is anxious to get a start in his profession as soon as possible and that generally means with inadequate capital. Capital accumulation by means of urban or outside employment is a slow and tedious process. While it is a possibility for a few it does not offer much hope for the majority. Gaining entry into farming as in any other profession requires sacrifices and a hard tedious climb to the top with failure waiting to trap any who make serious errors in judgment. The young graduate of a law school may hang up his shingle and wait for clients. The office will be rented, a desk will be purchased on credit and he may do his own typing. Income may be meager at the start. It is quite similar with farming.

Easier credit even with a highly developed selectivity of those receiving credit has some advantages. However, interviews with farmers lead me to believe it is not scarcity of credit that is a problem but rather it is the type of credit available which leads to difficulties. Intermediate credit is needed and we are moving toward an understanding of this problem. Credit is a tool available to the farmer just as machinery, land and buildings are tools to be used. However they must be used wisely and fully in order to be effective. Too much credit can lead to dangers for some. The "snub-loop" can effectively strangle one who has borrowed too freely as well as the farm operator who lacks capital.

Van Vliet seems to be concerned about the small number of men entering the farming profession and the difficulties of getting into farming. We do not need as many as we now have. Farmers are even paid to reduce production or take land out of cultivation. There is simply not room for all the men who desire farming as a career.

It is good that emphasis was placed on the need for better trained farmers. Management is the critical item and not lack of capital. The farm operator of the future will need all the skills, training and experience which can be acquired in order to be successful.

### CORPORATE ORGANIZATION OF FAMILY FARMS

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N. G. P. KRAUSZ University of Illinois

HEN property and income were subject to few taxes and capital investments were fairly small, self-operation with employees or a landlord-tenant agreement satisfied most farm owners. Today many farmers are subject to high estate, gift, inheritance, and income taxes, and their capital investment is quite large. These factors plus the growing need for more efficient farming and for continuity in a going business prompt many farmers to seek other forms of business organization. The farm corporation can, in some cases, meet this demand successfully.

It seems clear, however, that coporate organization has more to offer families owning large farms. If income is sufficiently high, there can be an income tax advantage. Substantial equity interests can be transferred during lifetime without dividing the farm and without relinquishing control over any part of it. This allows fair family settlements and avoids high death taxes and rising costs of probate administration. Continuity of operation is more easily provided for—the retirement, death or disability of a family member need not materially affect farm operating efficiency.

Let us then investigate.

## Advantages of Incorporation

## Easy distribution and transfer of ownership

It is common knowledge that ownership of corporation assets is divided into parts called shares, represented by certificates of stock. A share can be transferred by delivering the certificate to the new share holder and registering the transfer on the corporation books. The owner of a share of stock may sell it, leave it to a designated person by will, make a gift of it, or allow it to go to his heirs by the laws of descent without breaking up the business. Shares of stock also provide a simple way for the oncoming generation to gradually buy into the farm business.

Since stock issues are usually divisible into any number of shares and classes of shares, control can be maintained by the active management group. Control over the transfer of corporate shares can regulate the ownership of a corporation and affect the continuity of its management and business operations. Shareholders of a farm corporation therefore usually wish to place certain restrictions on transfer of shares. These can be stated in the preincorporation agreement, and should be placed in the by-laws or in the articles of incorporation after the corporation is organized.

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# Limited individual and corporate liability

A shareholder ordinarily is liable for debts of a corporation only to the extent of the shares of stock he owns unless he has signed as surety for a corporate debt. And just as the shareholder is not personally liable for corporate debts, a corporation has no liability for a shareholder's personal obligations.

When farming is only a part of an individual's total business enterprise, he should consider incorporating his farm business to protect his outside assets. Because a shareholder's liability is limited, only the assets he places in the farm corporation will be affected by farm profits or losses. For farmers planning an operation involving high risk (truck farming, sheep-feeding, etc.), the corporation is a means of limiting possible losses to the assets in the business.

This insulation against indebtedness extends to tort liability. The corporation is liable for damages inflicted by its employees, but not beyond the corporation.

In most cases the family farm corporation should have liability insurance protection. It is possible, of course, that the amount needed may be no less than if the operation were a partnership or sole proprietorship.

### Perpetual existence

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Individual proprietorships and partnerships legally terminate on the death of the proprietor or a partner, although by agreement a partnership business may continue. A corporation is not legally affected by the death of a shareholder.

A corporation exists as long as the shareholders desire it and it fulfills the requirements of the law. It can continue to function throughout the changes in ownership caused by one generation replacing another, because shares of stock, rather than farmland, livestock, and equipment, are passed to the next generation. This is of particular advantage when heirs exceed in number the farms devised.

## Possible increased efficiency

The very nature of incorporation compels the keeping of accurate records—something more easily neglected under other business systems. Keeping adequate records, advance planning, and reporting results, tend to promote efficiency.

The by-laws of a corporation usually designate how authority will be delegated, business policy, and organizational and operational procedures to be followed. This aids in reducing duplication of effort and conflict of policy, which may be present in more casual types of business organization. Although incorporation is not a substitute for the ability of the busi-

ness associates to get along, it can reduce sources of friction and it presents a means of settling business disputes more easily.

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Such a formal structural system often results in reduced expenses and increased profits.

### Tax advantages

If a farm family has a high net income, it is possible to reduce income taxes by incorporation. The first \$25,000 of taxable corporate income is taxed at 30 per cent. An additional 22 per cent is charged on income over \$25,000. The personal income tax rate for a married person is 30 per cent on taxable income from \$12,000 to \$16,000. It increases to 53 per cent at \$36,000.

At certain levels of farm income, therefore, current taxes may be reduced by splitting the income between the individual (or individuals) and the corporation. This may be done by paying out part of the corporate income as salaries and retaining the balance in the corporation as accumulated earnings.

Money retained in the corporation cannot later be paid out to the individual shareholders without further taxation. However, ordinary income is often shifted to capital gain. There is also the possibility that a higher tax basis will be obtained if one of the shareholders should die. (The new basis would be the market value of the shares at the time of his death.)

A married person operating his own farm business and receiving a taxable income larger than \$16,000 may incorporate with income tax saving by retaining part of the income in the corporation. (The tax rate for a single person goes over 30 per cent at \$8,000 and 53 per cent at \$18,000. Thus for a single person incorporation may reduce taxes if his taxable

TABLE 1. COMPARISON OF INCOME TAX FOR MARRIED FARMER UNDER INDIVIDUAL
PROPRIETORSHIP AND UNDER CORPORATE ORGANIZATION

Net earnings before salary	Distribution		Amount of tax
	Under individual proprietorship		
\$ 5,000	All to individual		\$ 660
15,000	All to individual		2,960
20,000	All to individual		4,532
40,000	All to individual		13,354
60,000	All to individual		24,176
,	Under corporate organization		,
5,000	\$ 5,000 salary to individual	\$ 660)	660
	none retained in corporation	none	000
15,000	\$15,000 salary to individual	2,960	2,960
	none retained in corporation	none \	2,000
20,000	\$17,000 salary to individual	3,560	4,460
	3,000 retained in corporation	900	1,100
40,000	\$17,000 salary to individual	3,560	10,460
	23,000 retained in corporation	6,900	10,400
60,000	\$35,000 salary to individual	10,800	18,300
	25,000 retained in corporation	7,500	10,000

income is greater than \$8,000.) Also, when a farm owner is in a high tax bracket because of substantial outside income, incorporation of the farm business may mean a tax saving.

It should be noted that when all of the income from an incorporated farm business is paid out as salaries to the owners, income tax liability is not increased by incorporation.

## Means of improving credit status and pooling capital

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Corporate organization, by bringing capital together under single unified control, may improve the credit status of the business.

There are several reasons for this increased financial strength. First, a corporation continues to function even though an owner (shareholder) should leave. There is continuity of operation. Second, lenders and investors prefer to deal with the unified and assumedly able management which they expect to find in a corporation. Third, the credit of a corporation is not impaired by the individual liabilities of a shareholder.

The second point is, of course, arguable. Incorporating does not necessarily elevate the level of management. However, to the degree that (1) younger members of the family, who may have had formal agricultural education and who usually are more prone to accept and to execute new ideas, are given or acquire a greater voice in decision-making, and (2) more and better records are kept, incorporation may promote management.

A corporation also allows a pooling of assets from various sources. People who for some reason cannot farm actively (urban relatives, friends of a farm family, or retired farmers) still can invest in the farm business. And two or more farm families who individually might not have enough capital to farm efficiently might use the assets they do have to best advantage by pooling them in a farm corporation.

There are natural limits to securing outside investment capital for a family farm corporation. Stock control rests in the farm family. Removing profits through salaries is a logical scheme of operation, since it avoids double taxation. The investor may find the divident cupboard bare.

## Disadvantages of Incorporation

## Initial cost of incorporation

A corporation must pay certain fees and taxes which are not required for other types of business organizations. Illinois is used as an example, since the writer is familiar with the rates used.

The Secretary of State charges fees for filing corporate statements or reports in his office. The fee is \$5 for filing an application to reserve a corporate name, \$20 for filing the articles of incorporation, and \$1 for filing most other statements and reports.

The following is an example of the total initial cost (not including professional fees) of incorporating a typical 200-acre Illinois cash-grain farm,

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#### The business:

Shares of stock issued	)
Value per share\$100	)
Number of shares authorized 2,000	)
Total proposed capitalization \$108,000	0
Date of incorporation September 1	5

#### The fees:

Initial filing fees\$	25.00
Initial license fee	
Initial franchise tax	45.00
Federal stamp tax	18.80

#### Tax disadvantages

A corporation is subject to at least the following taxes: (1) federal income tax and (2) state franchise, income or capital gains tax, and in some cases (3) federal excess profits tax.

Corporate income is subject to corporation income taxes and, when distributed as dividends, to individual income taxes. However, paying out most of the earnings as salaries or accumulating them in the corporation can eliminate much or all of this disadvantage. Care must be taken if cash accumulations exceed \$100,000. Above that figure, accumulations must be reasonably related to the business or be subjected to an extra tax of 27% to 38% per cent.

Another device for minimizing the income tax is to thin the corporation by using loans instead of stock investment. A bond or debenture bears interest which is deductible by the corporation. If a five or six per cent interest rate is used and the bond to stock ratio does not exceed 2 to 1, no trouble should be encountered from the revenue department. It is obvious that a substantial investment is necessary before this device overcomes the double tax disadvantage.

There is a federal stamp tax on the issuance of shares and, with few exceptions, all sales, agreements to sell, or gift transfers of shares of the corporation, after their original issue, are subject to a federal stamp transfer tax. This tax is approximately one-tenth of one per cent of the stock value.

State taxes are no small item. Using Illinois again, there is an annual

<sup>&</sup>lt;sup>1</sup> New tax amendments (September 2, 1958) provide for an election by stockholders of a small corporation to be taxed like a partnership.

franchise tax of 50 cents per \$1,000 of stated capital and paid-in surplus. A farm corporation is also subject to an annual capital stock tax. The amount of this tax is computed by deducting from the total value of the corporation the value of property which is assessed locally plus debts for current expenses. The difference is called capital stock value and is assessed on the same basis as other personal property. This tends to tax all of the corporation's personal property, including cash, whereas only about 20 per cent of non-corporation personalty is assessed in the state.

Most states have a corporation income tax. Rates vary from 1 to 8 per cent of net income, generally higher than rates on individuals.

### Formality of organization and operation

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State laws are quite specific about procedures required in operating a corporation. The management must be handled by shareholders, directors, and officers, each performing the duties and exercising the powers granted him by the law.

A nonincorporated business, on the other hand, is organized along whatever lines the owners find most suitable. Its management is guided largely by reason and custom.

Articles of incorporation must be completed in detail and properly filed and organization fees paid. Shareholders must meet to elect directors and adopt by-laws defining their powers and duties. Directors are required to meet and elect officers, resolve corporate policies and practices, and begin business.

Reports must be filed with the state when the corporation does certain things, such as increasing its capitalization or issuing additional shares. An annual report of business must also be filed.

A corporation is required to keep correct and complete books and records of account, minutes of the meetings of its shareholders and board of directors, and a record of its shareholders, their addresses, and the number and class of shares held by each.

The sales of shares in a farm corporation are usually exempt from registration under the securities laws, but the possibility of coming under them should be carefully checked. The Federal Securities act requires registration of securities when an issue over \$300,000 is offered to the public.

## Ownership and Management

In a "close" corporation ownership and management are substantially identical. Problems are created by differences in equity. Stock control does not necessarily coincide with management control in a family corporation. Members of the board of directors each have one vote, and a majority vote is binding. Since a choice of board members is limited in

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a family corporation, the big fist of stock control loses much of its punch.

The preincorporation agreement (shareholders's agreement) is being used by attorneys as a solution to many of the control and transfer problems of family corporations. It serves as a guide for the incorporators while the corporation is still in its formative stages and unable to act for itself. It may also be used to restrict the rights of shareholders in the purchase and transfer of shares, and to restrict the powers and duties of directors, officers, and shareholders in the operation of the business.

A preincorporation agreement for a farm corporation will usually in

clude the following:

(a) Agreement to incorporate. The incorporators agree that the corporation shall be organized, that it shall issue a given kind and number of shares, and that they agree to buy these shares or trade property for shares in stated amounts.

(b) Naming of employees, directors, officers, and their salaries. The agreement may name the shareholders who will work for the corporation, their duties, and their salaries. Since in a farm corporation the shareholders themselves usually will act as directors and officers, the agreement

should state which position each will occupy.

Decisions of directors and officers which the incorporators feel should require unanimous approval may be included in this agreement and later written into the articles of incorporation and by-laws. Regulation of shareholders' votes and quorum requirements must be made a part of the by-laws, but may also be included in this agreement for later adoption as by-laws.

(c) Restriction on stock transfers. Restrictions may be used to keep corporate control and assets in the hands of the original owners or selected successors. They may provide that, if any shareholder resigns from the employ of the corporation, attempts to sell, pledge, or otherwise encumber his stock, becomes ill or incapacitated for a certain period of time, or dies, the corporation or the other shareholders, in proportion to their holdings, shall have the right to purchase his shares. If this option to buy is to be a permanent restriction, it should also be included in the articles of incorporation.

An agreement for life insurance on the lives of the individual share-holders may be used to supplement the option to buy the shares of a deceased share holder. The surviving shareholders, the corporation, or an independent trustee is made beneficiary of the policy. The proceeds provide funds with which to pay the heirs, executor, or administrator of the deceased shareholder for the value of his shares.

(d) Evaluation of shares. If the method of valuing the shares is included in the preincorporation agreement, it will reduce the possibility of later disagreement when shares are transferred to a different owner. One or

more of the following methods may be used—(1) Book value method. (2) Mutual agreement among the shareholders. (3) Separate outside appraisal of the corporate assets.

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er or (e) Term. The preincorporation agreement may be for a temporary period or for a more permanent term. Usually the term is a set number of years (such as five or 10) and thereafter from year to year, thus continuing the agreement in force even after the corporation is organized. A clause can be inserted permitting the termination of this agreement by a majority (in number or interest) of the shareholders.

### Operation Under Corporation

The farm corporation has the same operating decisions to make as does the farm partnership, the landlord and tenant, or the single owneroperator. A corporate management system, however, handles such problems in a slightly different way from that in which they would be handled in the other types of business organizations.

There are three different management groups in a corporation, the share holders, the directors, and the officers. Each group has the power to authorize certain things and perform certain acts in the operation of the corporation, and since the shareholders are usually also the directors and the officers in a farm corporation, the same people will be performing the functions of all three groups.

The business and affairs of a corporation are managed by a board of directors. An individual director has no authority as such, and assent of a majority of the directors will not bind the corporation unless they act at a meeting as a "board."

The officers of a corporation are employed as its agents and the office itself confers no power to bind the corporation or to control its property. This power comes directly from the board of directors or is implied through custom and practice.

The president may sign contracts (including promissory notes) and perform other duties ordinarily part of the operation of the corporation's business, but he must have authority from the board of directors to enter into any unusual contracts, and the by-laws may require that he obtain approval of the board before he does certain other acts.

It would seem quite natural in some families to grant considerably more than usual powers to the officers where the parents are active officers and controlling stock owners. However, as parents graduate to retirement and as stock is more evenly distributed in the family, a reversion to democratic board action should result. As each generation advances, however, there may be a cycle of power concentration gradually shifting toward equality, not unlike the cycle of sole proprietorship and tenancy in common.

### Is There a Trend Toward Incorporating Family Farms?

As farms have increased in size and value and as operating capital needs have grown, concomitant with problems of personal and employee liability and substantially larger transfer taxes farmers have become inquisitive about partnerships and corporations. Joint tenancy is no longer the panacea for all ills.

Farm partnerships are increasing and, with properly drafted agreements, offer some advantages over an employer-employee or a landlordtenant relationship. But transfer and control flexibility are missing in a partnership, and particularly those farmers with sizable holdings and/or large families are seeking information about corporate organization.

A recent student survey of farm corporations in Illinois disclosed the following: (a) Thirteen farm corporations were reported. (b) Eleven of the thirteen are located in the northern one-third of the state. (c) Dates of incorporation ranged from 1950 to 1957. (d) Size of farms incorporated varied from 450 to 3,300 acres. (e) Over 75 per cent of the firms restricted shares to family members. However, most of the farms had professional managers. (f) Grain, livestock, and a combination of the two accounted for the types of farming in use. (g) The average annual net income in the past two years has exceeded \$15,000 per firm. (h) Estate settlement was the principal reason given for incorporating. Other reasons given were (1) limits corporate and individual liability, (2) keeps family together, (3) encourages all members of family to retain interest in farm land even though some are nonresident and (4) is easy to transfer interests. (i) No one expressed dissatisfaction with the corporate structure.

From this limited survey, it appears that in Illinois the average-sized family farm has not been incorporated. However, curiosity is present. A substantial number of the farmers visiting the Agricultural Law office to talk about corporate organization are in the 200- to 260-acre class. They are concerned about keeping the farm intact at death, transferring property by gift, death taxes, shifting management and some ownership to children, expansion capital, and personal liability. They want to know

whether a corporation will help to solve these problems.

#### Conclusion

It is possible that a family owning an average-sized farm will conclude that some points of advantage of incorporation outweigh incorporation costs, franchise taxes, and formal requirements of corporate operation. This may be particularly true if the family is large, thereby presenting inheritance problems, or when assets of family members must be pooled to expand the farm business, or when heirs of an estate find that they cannot economically divide the farm and wish to keep it intact. More often ship or be

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often, however, these persons find that a partnership, or a sole proprietorship with planned title arrangements, will solve their problems as well as or better than a corporation.

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Larger farms, with more equipment and employees, have a more serious liability problem. Insurance can be used whether or not the business is incorporated, but with a corporation any uncovered risk is limited and outside investments are protected.

Greater efficiency, higher production and increased net income may result with corporate operation. But again it seems logical that a larger operation may be more apt to benefit due to more resources, including additional family members who can be persuaded to stay on the farm.

# DISCUSSION: CORPORATE ORGANIZATION OF FAMILY FARMS

# W. H. YAW Farm Clinic of the United States

There is no question but that successful farmers faced with the problem of passing the land to their children and with keeping the land in a block for economy of scale are much attracted by the idea of incorporation. On the other hand, they are wary of an arrangement requiring too much legal counsel and paper work. Krausz has presented clearly and with objectivity the pros and cons of incorporation from the legal and financial points of view. His paper should be of assistance indeed to many who are asked to advise farmers about incorporating.

A changeable tax structure, both state and national, is an added hazard warranting serious consideration. Davis (of Colorado) did some work on California farm incorporations covering the years 1910 to 1951. In that 41 year period laws concerning taxation changed radically. Owners of land who incorporated primarily for tax savings found themselves in a less advantageous position a few years later. Added to this was the difficulty of limitations on water rights and availability of credit. There is no reason to believe the tax structure will not be changed in the future (Iowa situation).

Incorporations during this period varied between 1,745 and 5,400 from 1910 to 1944, rose sharply to 11,412 in 1945, then dropped steeply to 8,300 in 1951, the last date on which the California information has been compiled. From this it is also evident that incorporation is not a panacea for the obstacles in farming.

One point in the paper raises question—the suggestion that it is easier for a corporation to obtain credit. This would hinge on scale and diversity

of corporate assets. National policy, especially in times of stress, from on loans to corporate farms. The tendency is for lawmakers to protect single-ownership farms. On the other hand, an owner with a widely diversified financial statement has little difficulty with credit at any given time.

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At first glance it would seem that a scattered family with one farm would be best served by incorporation. However, observation says this does not seem to be true. If only one or two of the members expect to stay on the land, the most workable policy seems to be for full proprietor. ship to rest in his or their hands. Very often this process has already been started within the lifetime of the original owner. If the family gets along amicably, the rest of the heirs can be paid off with considerable flexibilty. If difficulties arise, usually the purchaser goes to an outside commercial or governmental source for funds, promptly paying off the remainder of the heirs.

A number of incorporated farms do come to mind that are typical of the minority of efficient commercial farming cases where incorporation is an advantage. Farming is a business characterized by anywhere from twice to four fold the investment per worker that industry invests. It is also a business characterized by much less time available for management. This is why perhaps the pictorial scene of the family working together, the younger members doing the immediate tasks at hand, the older members being more concerned with the strategic management tasks has been drawn as an ideal.

It is this same scene which is large enough, (1) to have adequate financial machinery at its fingertips, (2) to have a large enough supply of management for both the day-to-day and the strategic management, and (3) to permit the members of the family to specialize in some phase of the farm, that incorporation of the farming venture has its best chance of succeeding.

There are striking similarities in these cases. The volume of income from the land has always been relatively high. A number of children are involved. From the start of the family they all worked together, planning their lives with the object in mind of coming back to the land. After education, and possibly before or after marriage each individual returned to take charge and specialize in a particular area of farming in which he was most interested or had the most ability. Incorporation allows the development of a volume of business which lends itself to advantages of increment economies of scale. These situations are among our very best examples of efficient family farms. These are the farms in a position to capitalize on the industrialization of our agriculture which appears now to be at our doorstep.

Such incorporation can capitalize on the chief tax advantages of wages

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rather than dividends plus the capital gains accruals. Since wages must be reasonable in respect to services actually rendered to be deductible, there is no tax advantage at present in that area for absentee heirs.

Another area of family farm incorporation is the voluntary incorporation of several smaller farms for their mutual benefit. This has been done before for various reasons, i.e. 160 acre water limitations in California or as Miller (of Missouri) suggests could be done for more efficient use of resources. However, unless the object of incorporation goes beyond mere efficient use of the land, we come back to Krausz' position that in few cases are the advantages strong enough to justify the action.

I have been interested for some time in farmers accelerating decentralization of industry. This is visualized as small corporate businesses in which managerial ability, capital, technology and engineering are combined to utilize the products immediately at hand as raw materials to be processed to go both ways—back to the land and to outside markets. It is possible a little research in this area might also set the stage for industrial utilization of farm products.

An objective report on incorporation such as Krausz has presented to us is most valuable. It needs to be circulated and revised frequently so that we in applied economics have better access to present legalities and technicalities of various forms of land ownership.

## ROLE OF TECHNOLOGY IN ALTERING VALUE JUDGMENTS AND SOCIAL STRUCTURE

#### THE IMPACT OF TECHNOLOGY ON RURAL VALUES

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M. E. JOHN Pennsylvania State University

AN'S material environment is not limited as is that of the lower forms of animal life to land, water, air, fauna, flora, temperature and pressure. In addition, it includes the product of his ability to discover and create, such as fire, gunpowder, newspapers, churches, and rockets.1

The presence of objects such as these in man's environment is not only the product of his intellectual resourcefulness but also of his basic motiva-

The biological nature of man finds expression through socialized patterns of conduct. Certain processes come to have social signficance for the maintenance of the group and hence tend to be perpetuated. These crystallized patterns of behavior carry with them a concept of properness and desirableness. "In a choice situation, they act as vectors which polarize impulse and action."2 These socially defined criteria which control the selection of everyday means and ends are called values. They include such abstract concepts as comfort, security in all of its forms, status, and physical well-being.

Because values are abstract it is difficult to measure the degree to which they are met. Furthermore, one's expectations and aspirations keep expanding as the new is developed. Value systems are never completely satisfied. It is this constant striving to satisfy an ever-demanding value system that motivates man to develop innovations.

In every culture there are well-defined means to be followed in seeking to satisfy the value system. These commonly sanctioned methods serve to guide mental processes in creatively seeking ways to come closer to meeting the value system. To this extent the value system gives direction to technology.

Many times a product of an individual's or group's creativity is not accepted by the larger society if it fails to be defined as a maximization of the commonly held values. So values not only guide the direction of human ingenuity, they serve as criteria by which products are judged for acceptance or rejection.3

<sup>&</sup>lt;sup>1</sup> Allen, Hart, Miller, Ogburn, Nimkoff, Technology and Social Change, New York: Appleton-Century-Crofts, Inc., 1957. Chapter 1, p. 7.

Robin Williams, Summary of Discussions of the Cornell Value Study Group,

June 11, 1949, unpublished, p. 4.

<sup>\*</sup>For a fuller discussion of the role of "man's will" in directing technology see, Allen, Hart, Miller, Ogburn, Nimkoff, Technology of Social Change, New York: Appleton-Century-Crofts, Inc., 1957, p. 18.

As the value system helps to determine the direction of technology, technology likewise slowly remolds the goals and ways of obtaining them.

A major innovation introduces changes in three ways. First, it frequently brings about obsolescence in other products and processes. The development of the automobile and hard surfaced roads along with commercial air service has made the horse and buggy old-fashioned. Likewise, the development of technology in agriculture has eliminated the "threshing ring." Innovation, therefore, frequently brings both pleasure and pain, and demands additional innovation to solve newly created problems.

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y see, York: Secondly, innovations demand a reorganization of related production processes. This is clearly seen when a far-reaching invention reaches the farm or factory. Since management processes are so interrelated with machines and men, an introduction of a new machine will require far-reaching reorganization of the production process to maximize its contribution to economic efficiency. If the innovation demands too great a reorganization, adoption may be retarded.

The third type of change that a major innovation demands is social-psychological in nature. Innovations often produce unanticipated consequences which can create serious social problems. Television is not all "good," as defined by our value system, nor is the automobile or atomic energy. The festering social problems created by innovations are part of the aftermath and frequently demand additional social innovations to solve them. In some cases, adjustments in our value system are made, slowly and painfully, so that we come eventually to live happily with the consequences of material invention. A good example of this is the change in the concept "freedom." As society has become complex with the activities of each of us having greater effects on our welfare, we have gradually given up more and more individual freedom in order to protect that which we have left.

Someone has rightly said that change breeds change. Part of this grows out of the fact that innovation usually adds to knowledge, which, in turn, opens up the way for further developments.

In considering the impact of technology on rural values, I will restrict the discussion to three areas; (1) communication and transportation; (2) farm production; and (3) the household.

It is so obvious that I hesitate to mention that the major impact of technology in communication is to speed up the process of change. An innovation is brought to the attention of the masses much more quickly than years ago. Also with our present day knowledge of the techniques for instigating acceptance of change, present day media can be made more effective than in the past. For instance, in the introduction of a new innovation over television or through the printed page, care is taken to point out to the listener or reader how the new innovation will serve as a more

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effective means for achieving desired goals. In bringing about a change in institutions, we try to aid people in ordering or reordering their values, frequently by pointing out the necessity of de-emphasizing some values for the sake of others. Most accepted innovations, in spite of their apparent good qualities, demand some reshuffling of values. For example, better education through consolidation of elementary and secondary schools comes as the result of giving up some cherished local control Mass communication helps to bring about this necessary reordering of values.

It is well known that the industrial revolution has had its greatest effect on agriculture in the last few decades. The availability of machinery to do work on the farm brought about a profound change in man's attitude toward work. The traditional rural attitude as handed down from the Calvinistic philosophy was that success comes to those who work hard and endure hardships.4 While man for many years used innovations, they were used primarily to increase his output rather than to make the job easier. In essence, hard physical work had high value because it "paid off." With the great increase in mechanization of agriculture, and larger managerial units of production, good planning in the use of resources has become more important than hard physical work. Consequently, the concept of what is work and its relative importance in the value system has changed. Currently the farmer who "uses his head" is respected more than one who excels in brawn. Also, if you can obtain a machine that will perform an essential task more rapidly, more cheaply and more easily, you are considered wise.

As the attitude toward work has changed, likewise the attitude toward rest and leisure has changed. Years ago leisure was not part of the "every-day man's" life. Leisure was thought of as belonging to retirement or to the wealthy who did not have to work. In the first instance, leisure was a reward for past hard work, and in the second instance, a sin. As the family income increased in purchasing power, more and more people could maximize their satisfactions by working less and devoting an increasing amount of time in spending money for experiences they enjoy. In the allocation of one's time between production and consumption, the proportion spent in strictly consumption activities increases with income. As one middle-aged man said following World War II, "I made lots of money during the war but it was no good. I worked so hard and long that I didn't have time to enjoy myself and what good is the money if you do not have time to enjoy it."

While the idea of leisure time is rather recent for the working class, this does not mean that previously they worked all the time. It was necessary

<sup>&</sup>lt;sup>4</sup> Max Weber, The Protestant Ethic, Scribners, p. 98-128.

to take time to rest. "To rest" meant exerting as little effort as possible. When one devoted time allocated to resting in active leisure pursuits, it was commonly felt that he might as well be working.

As the value placed on work, rest and leisure has changed, so has the concept of comfort. When a farmer made an investment in his production processes, it was done under the justification that it would pay for itself. When he made an investment in the house by adding a modern convenience as running water, electricity or central heating, it was done to raise the level of living by adding to comfort. The motive for financial investment on the farm and in the house was quite different. But today technology has modified the farmer's criteria for purchasing a new innovation in relation to his farm operation. With the change in the attitude toward work, farmers are looking for ways to make their work easier and more enjoyable. In a study of the economics of mechanical gutter cleaners in dairy barns conducted at the Pennsylvania State University, it was found that some farmers did not try to justify their purchase on an economic basis but simply said they purchased it because they were tired of shoveling manure.5 The concept of higher level of living is no longer confined to modern conveniences in the home but also include the easier, more enjoyable methods of doing farm work. This increases the difficulty of decision-making because the additional criteria complicate the evaluation of new investments in farm equipment.

Likewise labor efficiency is no longer restricted to the farm, for today one of the arguments for adding certain modern equipment in the home is that it saves labor. Years ago "women's work" was thought of as having low economic value, but with the opportunities for employment available outside the home, labor-saving devices are considered worthy. Thus the criteria governing expenditures in the household and on the farm are becoming more similar.

Twenty odd years ago, Carl Taylor wrote that rural and urban people could be contrasted in the way they used money to contribute to status. He stated that in the city, social position was determined by the level of living, the house lived in, clubs belonged to, the car driven and the manner of dress. In rural areas social position was determined by the amount of accumulation the property owned and paid for and the money in the bank.<sup>6</sup> With the new rural attitudes toward work, leisure, and comfort, rural people are taking on the status values of urban society.

Through the application of knowledge to agriculture, farmers have become convinced of the contribution of research and education in the attainment of their goals. This acceptance is an achievement that has

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<sup>5</sup> Study in process.

<sup>&</sup>lt;sup>6</sup> Carl Taylor, Rural Sociology, New York: Harper and Brothers, 1933.

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taken years to acquire. Contrary to what one might expect, the honest-to-goodness farmers were not the first to show interest in the application of science to agriculture. One of the first organized groups dedicated to the promotion of science agriculture was organized in 1785 as the Philadelphia Society for the promotion of agriculture. Its members included gentlemen farmers, among them Benjamin Franklin and Dr. Benjamin Rush. Farmers were skeptical of "book farming," and graduates of our early agricultural colleges who ventured to return to farming re-entered their communities with one strike against them. But times have changed. Farmers expect that better varieties of crops, feeding practices and cropping practices will constantly flow from industries, seed companies and universities. In fact, farmers reflect such a confidence in the advantages of the new that some will accept it before it is sufficiently tested. As in early years, suspicion of the new retarded desirable adoption; thus, to day an unwarranted favorableness toward the new encourages adoption prematurely.

The public's attitude toward farming had always been favorable. "In Jefferson's view the agrarian way of life and the democratic were synonymous."7 The family farm historically manifested so many of the cherished values of the American culture that it has taken on a moral prestige. The image of the family farm was one that exemplifies tangible ownership, freedom of enterprise and total family participation and devotion. The requirements of the occupation demanded hard work, regularity of habits and resourcefulness. The agricultural community through its primary group relationship reinforced the beliefs and values held. Out of this setting there developed a reverence for land and farming that was expressed by Jefferson in a letter to Adams in 1794. "I have often thought that if heaven had given me choice of my position and calling, it should have been on a rich spot of earth, well-watered, and near a good market for the productions of the garden. No occupation is so delightful to me as the culture of the earth."8 Yet the farmer was also thought of as a "country hick" and socially inadequate. This public definition was internalized into his own feeling of inferiority.

Since our nation is rooted in agriculture, many of the agrarian values and concepts have penetrated our total culture. As a result, the farmer carried the respect and sympathy of the nation. This is revealed by the content of the reports of government committees and congressional action on farm policy. We can then ask, what effect is technology having on

A. W. Griswold, Farming and Democracy, New York: Harcourt, Brace and Company, 1958, p. 14.

Ibid. p. 24.
 O. B. Jesness, and others, Readings on Agricultural Policy, The Blakiston Company, 1949, Chapter 1 by Joseph S. Davis.

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these cherished ideals of American agriculture? First, we must say that much of the romanticism of land still exists. The desire to own a piece of land runs high in American life today. But the concept of farming as a way of life, quite different from other occupations, is rapidly changing largely due to technology. Family members no longer work side by side in the fields. Nor is there the same family feeling of accomplishment from a well-stocked larder. Technology is making farming a man's job rather than a family's job. Gradually but slowly the way of life of the farmer and those in other occupations are becoming similar. As agriculture loses its differentiating characteristics as a family occupation, some of the public reverence for the farmer and his family will undoubtedly decline. More and more he will find it necessary to fight his own battles before Congress.

So much for farming as a social value. Now what has been the effect of technology on the farmer's feeling of his role in the social system? Years ago the farmer felt he was largely responsible for his own success or failure. Through hard work, careful spending, and with a reasonable break from the weather, he would make out. He felt that success or failure centered in him. But with specialization and a highly interdependent economic system he has discovered that the application of best known farming practices and favorable weather can produce a surplus that on an open market would destroy him. He has also discovered that technology in agriculture gives the one who can afford to buy it an advantage for survival in economic competition. As a result, many farmers feel they are being unduly punished by an economic and social system that is beyond their control. They also feel that this complex system has a responsibility to them. So many farmers are willing to compromise their independence, asking the government for help, accepting restrictions on freedom. This is a terrific departure from the traditional rural values centering around farming as a way of life.

In conclusion, what are the implications to be drawn from these comments? It has been stressed at several points in this paper that farmers have become more and more willing to accept change. Undoubtedly this trend will continue. This means that the agricultural extension service will find a more receptive audience demanding more information than in the past. Farmers will show increased interest in research and grow increasingly impatient with the slow process involved in arriving at tested conclusions. Agricultural experiment stations and the Department of Agriculture will have greater support than ever before from the farming population. Farmers will read diligently the publications of the farm press for new and better methods. Farm supply companies will find growing interest in their new products. To be modern, up-to-date, with the latest equipment will take on a moral content, giving status in much the same way as "thrift" did 30 years ago.

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Farmers will accept more readily the impact that broad social changes have on them and will be less likely to resist adjustments needed to remain successful. They will tackle the problems created by change, both individually and in groups, employing many new social innovations as solutions. Government programs will be less distasteful. They may tend to be designed in the future to give advantage to the farmer who makes adjustment to change. Less will be heard about sacrificing of individual freedom and control and more and more about the need to meet changing times.

Farmers, because of increased contacts and the change in the nature of the business of farming, are losing some of their feeling of inferiority. They are becoming more venturesome, throwing off some of their traditional fears of credit and debt. Mechanization will continue to demand more risk-taking. As the management principles relating to farming and other businesses come to be recognized as similar, more urban people will invest in agriculture and more farmers will invest in town businesses.

Farmers will continue to look for ways to improve their standard of living both by adding new conveniences in the home and by making farming easier and more pleasant through mechanization. All of these things will make it difficult to start and perhaps to remain in farming, but will add to its prestige among the occupations.

#### DISCUSSION: IMPACT OF TECHNOLOGY ON RURAL VALUES'

JOHN H. SOUTHERN
Agricultural Research Service, USDA

John has furnished us a take-off point for our session by introducing this meeting to the role of technology in value judgments and social structures. He has a socio-psychological definition of values which is broad enough to include all aspects of our subject when he says that values are socially defined criteria which "control the selection of every day means and ends." These controls he would call values. He limited himself to the impact of technology on rural values in three areas; namely, (1) communication and transportation; (2) farm production; and (3) the household. In doing this he defined the limits within which he proposed to treat the impact of technology on the value system of agriculture.

<sup>\*</sup> The opinions expressed in this paper are those of the author and do not necessarily represent the views of the Farm Economics Research Division, Agricultum Research Service, or USDA.

<sup>&</sup>lt;sup>1</sup> For an excellent discussion of values and economic analysis see John Maurice Clark, *Economic Institutions and Human Welfare*, New York: Alfred A. Knopf Publisher, 1957.

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I find myself in general agreement with what John has to say. But I feel that his presentation furnishes a general rather than a specific look at technology and its impact on our value system. When one generalizes about the impact of technology on rural values he may run the risk of overlooking some concepts or pertinent specific values which long have been associated with farming. For example, the values of "comfort", "security", and status", which he mentions in the introduction of his paper have no peculiar reference to agriculture, but this is not the case with such values as the "family farm", the "virtues of rural life", "the dignity of farmer independence", "conservation", etc.

At this point it may be well to examine further the concept "value" as we are considering it here. Simply stated, a value recognizes or accepts a desirable end to be achieved. As such it must be realized that values generally are not only abstract as John states, but are ambiguous as well. For example, there are different ways of being independent. In contrast to the subsistence farmer, the farmer who is highly commercial in his operations may give up certain independence because as a seller and a buyer he is dependent almost wholly on the operations of the market place. Positivism has led to the consideration of values as arbitrary, but on the other hand certain values undoubtedly have their normative character. And it follows in such cases that commitments may be based on the normative character of a specific value or set of values. If it is true that values are ambiguous, they must be subject to revision. Therefore, we should subject values to thorough examination as to their current validity and as to the means by which we strive to attain a desirable end.

In bringing technology and its impact into sharper focus could we consider values as a dichotomy, comprising applied and basic elements? The applied values would be those serving welfare and well-being, or in this instance broadly guiding technology toward socio-material well-being of the individual and the firm. A basic value, similar in character to what is termed basic science, might be considered to be one held with no particular use or end in view, or at least of no practical use. My first observation is that adjustments toward a technological agriculture involve values of an applied nature. And as the tide of technology becomes more swift it increasingly demands that the values associated with it, or the values which control the every day means and ends, must be of an applied nature. In taking this approach we perhaps can determine to some degree the validity of certain values as applied to agriculture. Immediately, one would have to say that in our highly developed technology, efficiency is the greatest single relevant applied value. It has become paramount in the agricultural firm and in our profession, almost to the exclusion of other values. At the same time, values which might be termed basic, such as

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those quoted by John wherein agrarian life and democracy are viewed as synonymous, may have little or no relevance in technological farming but at the same time because they are values they can create confusion in policy considerations. The virtues supposedly inherent in rural life cannot pay the mounting capital requirements of farming as an occupation. One could go further and classify certain other values as to their basic or applied nature, but perhaps this presentation suffices for illustration.

Also, in dealing with this subject we should recognize that technology, per se, may be a value and therefore normative. But over and above this it has to be considered as an institutional force to which we are committed and as such it is irreversible, assuming that man will have sense enough to control his own destiny and not destroy himself along with his technology, A discussant in a paper some months ago pointed out that technology, defined broadly as including management, is the main current of the stream that is fashioning a new agriculture with a new set of values, or at least bringing to the surface those values which long have been accepted in other segments of our economy.2 This technology, with its demands on the individual farm family and firm, is directly responsible for shaping the farm business, the farm family life and the values that go with it. A technology that requires large segments of agriculture to purchase 60 to 80 per cent of its supplies from the nonfarm economy also dictates that the value of digging in the earth for one's bread is no longer a luxury that can be enjoyed and held, if such was ever the case. Adjustment to agricultural technology does not operate in isolation, but is closely interrelated with adjustment to technological change in the entire economy. The integration of certain farm enterprises with off-farm supply and processing firms has resulted from this broad change and from the efficiency value mentioned earlier. As John recognized, the family living and home do not escape the impact of technology. No longer is the household left for residual income, but the farm family now values its modern kitchen and other modern home facilities as highly as it does the new 16-foot self-propelled combine. It also places a higher value on the education of family members as shown by children staying in school when formerly they were taken out of school everytime a major operation had to be performed on the farm. Also, women, and in many cases even the children, are no longer part of the family labor force. We see large numbers of low production and low income farmers earning and spending increased off-farm income, not for investment and reorganization and adjustment of the farm business, but to raise their level of living to more nearly acceptable standards. They

<sup>&</sup>lt;sup>2</sup> John H. Southern, *The New Agricultural Community*, Texas Extension Service, College Station, Texas, January, 1957.

are willing to give up the values supposedly inherent in subsistence farming for other values which make them *more* not less dependent on others.

In conclusion I suggest that we as researchers have done too little investigation of technology and its relationship to values and value change. We are faced suddenly with the fact that rapidly developing technological adjustments challenge long held values. Unless such study becomes a part of our activities, it may be that we shall continue the confusion in policy and adjustments by pursuing a set of values which may or may not be relevant.

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## FARM POLITICAL POWER AND THE U. S. GOVERNMENTAL CRISIS

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CHARLES M. HARDIN
The University of Chicago

against the major political fact of our time—the radical deterioration of American political power and the dangerous inadequacy of both our political institutions and ideals. Until recently all this would have seemed different except for those cursed with foresight of the Russian breakthrough in the autumn of 1957; until recently we might have concentrated upon appraising farm political power for its probable consequences on farm policy. We can and will still make this kind of interpretation, but we must in all conscience start from and return to the larger issues,

Despite its historical success, the U.S. Constitution is no longer adequate for the modern world.1 First, the constitution relies too much on the Presidential leadership without recognizing the presidential need both for the support and for the limitation of disciplined and responsible national political parties (his own and the opposition). Second, it has no means of replacing a president who becomes politically-and not merely physically -disabled. Third, its calendar elections now invite the enemy to plan harassments years in advance to mature when the United States will be highly vulnerable by iron chronology (say in October of presidential election years). Fourth, elections are too frequent and too staggered; governments need more time to develop and test programs than biennial Congressional elections permit; they also need greater cohesion than is implied by two, four, and six year terms for Congressmen, President, and Senators, respectively. Closely connected is the constitutional fault, steadily becoming more serious, of frequent and interminable electoral campaigns which drain the energies and jeopardize the health of statesmen, distract the public, and bring democracy into disrepute.

Fifth, many of the political institutions, organizations, and practices as well as much of the going political ideology in the United States conspire to elevate local, special, separate, and "pluralistic" interests—despite the fact that national survival now depends upon the ability to fix political attention steadily upon national problems and interests. Sixth, and finally, such constitutional infirmities, and especially this overweaning localism, compel the United States unduly to magnify its one essentially national institution, the presidency—and induce it also to try to fill the gap by con-

<sup>&</sup>lt;sup>1</sup> Charles M. Hardin, paper "Constitutional Reform in the United States," January 15, 1958. Expanded from an address at Oregon State College, December, 1957.

juring up "public opinion" through methods which Walter Lippmann, Lindsay Rogers, and Kurt Riezler<sup>2</sup> have shown are based upon a dangerous misunderstanding of the nature and proper role of public opinion in a democracy.

These are the somber premises of the following discussion of farm politics.

Farm Political Power in the United States: A Preliminary Evaluation

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Historically, farm politics has had many consequences, some good, some bad, and some indifferent. The most salient features of farm politics seem now to be harmful to the national interest. As it true of many other kinds of political power in the U. S., that of farmers works two ways; now dividing and subdividing power, now centralizing and concentrating it. Political energies derived from rural issues multiply political aims, groups, and agencies. A multitude of rural interests has been organized; each of them tends to get its quota, its protection, its promotional agency, its special form of credit, and/or its research and educational services—together with its vested position in Congress and the bureaucracy, both state and federal.

Conversely farm politics has also enormously centralized power. The fact that virtually no economic regulation remains outside the scope of federal power can be largely attributed to farm politicians—many of them the fathers of those who now shout the loudest for *laissez faire*. Political programs to help farmers get parity have required national action through price support and production control, through the Commodity Credit Corporation with a twelve billion dollar stake, through fat annual appropriations, through a line administration from Washington to the last farm on the last creek, through modifications on economic foreign policy to protect domestic farm programs from imports, through special deals for particular commodities, and finally through a massively financed program to get rid of farm surpluses abroad.

Regardless of detailed criticisms appropriate to much of the foregoing the general effect of farm politics would be supportable had not the "terms of political trade" (to counterfeit a phrase) suddenly turned against America. Now the genius of farm politics (as that of much group politics) works evil—to subdivide policy issues and to insist that each be treated separately—"on its own merits." I refer especially to the continuous compulsion, presently in a high phase, to develop separate commodity programs. The political grasp of many American agriculturalists now seems to be like that of the British pig farmers who saw the silver lining even in

<sup>&</sup>lt;sup>2</sup>Respectively, *The Public Philosophy*, (1954), *The Pollsters*, (1949), and "Political Decision Making in Modern Society," *ETHICS*, (2), January, 1954.

Hitler's conquest of the continent—they no longer needed to worry about imports of Danish bacon!

Now to examine farm politics in more detail.

#### Characteristics and Trends

To evaluate the power and influence of a group in a constitutional democracy requires examination of its electoral strength, its strategic position in the legislative and other policy-making processes, its articulation into politically vocal groups (as well as their cohesiveness and the ability of their leaders), of its alliances, of the relevant public attitudes towards its political activities, and of its relationships to the going political values and beliefs in the community in question.

#### Electoral Power of Farmers

Since the farm population continues to shrink, the farm vote may loom less in political calculations. The rural farm percentage of the population declined from 23 in 1940 to 11 in 1958 and will probably drop to seven or eight in 1965. It would be rash to conclude that farmers' political influence will decline proportionately. Long ago the farm vote ceased to determine which party occupies the White House or controls Congress. Even in 1928 the Republicans could insult organized agriculture and still win by a landslide. Subsequent governmental programs and expenditures for agriculture show, however, that the farm sector may prosper politically even though its numbers decline. The paradox may be explained by noting that after the federal lands had been alienated and until the Great Depression the national government offered little positive support to seetors of the economy, although agriculture shared well in what little there was. Once the federal government became committed to regulate, to support, and to spend, farm political power insured its own sector a healthy share of the proceeds.

The very large rural share of the handful of men who really run Congress shall be stressed here. Consider the House of Representatives. Speaker Sam Rayburn's district was 31 per cent rural farms in 1950 when the national percentage was 15.3. The House of Representatives has 19 Standing Committees. In January, 1958, 12 of these committees were chairmanned by men from rural-farm districts. Among other powers, committee chairmen usually arrange agendas of committees, appoint sub-committees and refer bills to them and often decide if and when measures shall be considered. They approve lists of witnesses, appoint committee staffs, preside at meetings, handle reported legislation on the floor and select and lead house managers in conferences with the Senate on legislation. Members become chairmen through seniority; hence, the safer the Congres-

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sional district the more likely its incumbent will become, and the longer he will remain, a committee chairman.

Among the safest districts are those in the rural South. The number of chairmen proportionate to farmers in the population would be three or four. Rural chairmen lead the Rules committee which, with the Speaker, controls the agenda of the House of Representatives, and the Ways and Means committee, Democratic members of which also constitute their party's committee on committees.

Table 1. Committee Chairmen, 85th Congress, First Session\*

Committee	Chairman	State	District number	Percentage rural farm (1950)
Agriculture	Harold D. Cooley	N. C.	4	40
Appropriations	Clarence Cannon	Mo.	9	41
Armed Services	Carl Vinson	Ga.	6	27
Banking & Currency	Brent Spence	Ky.	5	22
Education & Labor	Graham A. Barden	N. C.	3	40
House Administration	Omar Burleson	Texas	17	24
Interstate and Foreign Commerce	Oren Harris	Ark.	4	35
Merchant Marine and Fisheries	Herbert C. Bonner	N. C.	1	42
Post Office and Civil Service	Tom Murray	Tenn.	4	50
Rules	Howard W. Smith	Va.	8	37
Veteran's Affairs	Olin E. Teague	Texas	13	22
Ways and Means	Wilbur Mills	Ark.	2	50

\* Data from Congressional Directory, 85th Cong., 1st Sess., Jan., 1958, and Appendix G, Bureau of the Census, U. S. Dept. of Commerce; County and City Data Book, 1956. The District of Columbia Committee is omitted and the Rules Committee is added.

This southern rural predominance in the House of Representatives promises to continue indefinitely because of election prospects and the seniority chain. If the Southern Democrats should split the Presidental party over the racial issue, they would probably take care to retain Congressional "cohesion"; and if the Congressional party splits, committee control would shift to northern small-town and rural Republicans, hardly less sympathetic to farm interests.

The only other threat to southern rural hegemony in the House of Representatives is that present chairmen may die or retire, thus yielding to northern metropolitan Democrats with high seniority. But when Representative Jere Cooper of Tennessee recently died, the chairmanship of the House Ways and Means Committee passed to Representative Mills of Arkansas whose district was 55 per cent rural farm in 1950 and he is backstopped by Gregory of Kentucky (40 per cent rural farm); and Southern Democrats enjoy "defense in depth" on seven other standing committees.

Perhaps the greatest strain is placed on agriculture's political cohesiveness by the fact that the main strength of most farm organizations lies in the Midwest and in the North, generally, while the farmers' chief govern-

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mental vantage point (as noted) is in Southern rural Congressional leaders. The union of cotton and corn that provided the major political base for New Deal farm programs has often been under stress, manifested by Congress' pulling one way while the Farm Bureau (officially, at least) pulled another. Partisan loyalties, stemming especially out of the Civil War, are strengthened by such economic conflicts as those of dairy versus cotton (cotton-seed interests have supported margarine against butter, and established dairy areas have feared that the South would shift out of cotton into milk production). Both differences are reinforced by ideological disagreements respecting the role of government in the economy. In

portant east-west intra-agricultural controversies also exist.

Friction within the farm sector also arises from the commodity versus the general-farm approach to policy. This conflict is difficult to appraise In the 1920's farm policy was approached essentially by commodities in the Sapiro and McNary-Haugen movements as well as by the Federal Farm board. Parity and the first Agricultural Adjustment Agency (AAA) had a general agricultural orientation but the administration was by commodities; and the AAA of 1938 was really a series of separate acts, each with its own legislative finding and its own provisions for a single commodity, although USDA administration now had (superficially, at least) a more general organization in the regional offices of the AAA, One could trace this line down through the establishment of the Production and Marketing administration commodity divisions in 1945 to the widespread current demands for new commodity approaches. The Fam Bureau, despite its strong commodity departments, has moved toward a more general program, emphasizing the free market and reliance upon fiscal and monetary policy. Bound up with the commodity-versus-general argument is the Farm Bureau-Farmers Union schism, the latter organization stoutly maintaining that "farm prices are made in Washington" which should, therefore, guarantee farmers 100 per cent of parity; for the kind of tight-control, high-price-support program tends to be argued along commodity lines. Meanwhile, the Grange espouses commodity approaches, although (for dairy products, at least) they dream of a miraculous self-help program that would prosper farmers, nourish consumers, and cost government nothing.

Nevertheless—and despite all these internal schisms, the farm sector is a political collectivity—and it has the farm price (and related) programs, the Department of Agriculture, the Commodity Credit Corporation, Public Law 480, and the massive agricultural appropriations to prove it.

What is the nature of agriculture's political influence?

The farm sector has influence rather than power (which implies ability to threaten a legislator with defeat). Many legislators welcome farm organizational staff work and enjoy their political endorsement. Farm

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be ag ar journals and meetings are valuable means for candidates to fix electoral images of themselves. Indirectly farm organizations may help bring out the vote-the more vigorous their group life (sharing committee work, socializing, etc.) the more people are likely to take part in elections. But formal organizations seemingly cannot change their members votes. Numerous efforts to do so have been unsuccessful. A major proposition of political sociology holds that formal organizations have their way politically only if the "underlying interests" or the "potential" or "incipient" groups are indifferent or are going in the same direction.

To many farm policy issues (such as credit, conservation, taxation of cooperatives, research and education) underlying groups are seemingly indifferent. Their effectiveness on farm price policies and tariffs is often exaggerated. Politicians' estimates of farm voting shifts may greatly influence their stands on such matters without any reciprocal effect of this stand upon the vote itself. The voter-party-candidate-issue relationship is cloudy; but in the United States we can probably say that the really major recent electoral shifts involving large numbers of the "underlying groups" seem to have been motivated by fear of depression or of war. It is likely that what the politician actually does on specific policy matters often has little effect on how his constituency votes which depends on whether his party is rising or falling, for obscure reasons, in public favor. The consequences of this inherently murky situation and its misinterpretation have sometimes been highly unfortunate for farm policy; they may become disastrous for foreign and military policy.

To recapitulate, formal farm organizations apparently have had much influence on some policy issues. Their effectiveness seems to be produced by their ability to help politicians inform themselves, by the friendship (and, indeed, the social identification) between their leaders and politicians, and by their invaluable assistance in helping candidates to adver-

tise.

### Relationships with other groups and sectors

Farmers do not make part of an alliance which controls United States politics, as Schumpeter declared that the English landlords once did, in league with commercial interests; and as Gerschenkron wrote that the German junkers did, in league with the ironmasters. Historical efforts to build farm labor political parties have been unsuccessful, except briefly and within single states. The more informal New Deal (Roosevelt) coalition, including farmers and laborers, lasted at most from 1934 to 1937; certainly it was broken by November, 1938. Since that time there have been ad hoc agreements, but I know of no lasting coalition between major agricultural and other aggregations which have controlled significant areas of public policies. If I am correct then Wesley McCune and Matt

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ability farm Farm Triggs are both mistaken. McCune's implication (in Who's Behind Our Farm Policy?) that a Cornell-Big-Business-Farm Bureau network dominates farm policy by substituting flexible for high fixed price supports is incompatible with the fact that flexible prices have found considerable acceptance or, at least, aquiescence among great numbers of farmers as well as among many others who are by no means identified with his "Interlocking Power Groups in Agricultural Policy." In view of the previous analysis of agriculture's tremendous weight in the governing circles of Congress, Triggs' implication (in American Agriculture for June, 1958) that labor is emerging as the dominant partner in a nefarious alliance with farm politicians in Congress is absurd—What has labor gained from its

share in this "conspiracy"?

Farm groups have been part of transient political deals. In the 1980's peanuts reportedly became a basic commodity in an arrangement which passed the Guffey Coal act, and votes were traded to insure support for both farm and relief appropriations. During the war farm-labor cooperation gave way to friction over price controls and the so-called wage-price spiral. In 1946 the National Farmers Union along with organized labor was a prime mover behind full employment legislation, but the much more conservative Employment act reflected the countering influence of a Farm Bureau-business coalition. Meanwhile, the Farm Bureau has maintained its attack upon numerous union activities and has joined in many states, though not in all, to help outlaw union shops. The Farmers Union and labor unions, especially the United Auto Workers, celebrate their political agreement just as many people make a good thing of cultivating the numerous links between business and agriculture. One of Wesley McCune's most mordantly amusing passages recalls the Madison Avenue treatment given the American Association of Agricultural College Editors in 1955.

In sum, however, the agricultural interest in the United States is not part of a governing coalition, as once were the great lauded estates in Chile, Argentina, and Mexico. There are numerous and ordinarily fragile political combinations with other groups, but there is no Grand Alliance. This conclusion is in keeping with the nature of group power in agriculture, allowing, as it does, for internal schisms and for tendencies of commodity or sectional interests to operate independently. It is also consistent with the major contributions of agriculture to political ideology in the U. S.

### Ideology

Farm politics has fostered the broad political expectation that government is obligated in the United States to help people in economic difficulties. The idea of "parity", working subtly in the American political creed, may have consequences by no means yet revealed; for parity suggests that society is made of politically significant groups whose incomes

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should all be made comparable, if necessary, by public support. Beyond this, farm politics has contributed, sometimes in an obscure way, to numerous other aspects of American political ideology, and especially to populism (into which lack of space prevents inquiry here) and to pluralism (discussed in the conclusion).

#### The Inferences for Farm Policy

Farm political power remains formidable in the United States. Any loss from decline in numbers is made up by the intrenched farm positions in the ruling Congressional clique. Reaching into this major locus of strength are communication lines of farm organizations, linked with friendly groups. Behind these visible aggregates are the underlying interests. Despite its family quarrels the farm sector is cohesive enough to be effective politically, although I do not mean to imply that farm policy is produced solely by power. Study of the evolution of parity shows that the concept was shaped by imaginative men who labored to define, quantify, and interpret the agricultural disadvantage which was sharply felt in the 1920's; by the state of the statistical arts; and by the institutional development of farm marketing and farm finance-all these operators, facilitators, or conditions figured together with the political power of the farm interest in the emergence of the major U. S. farm policy. A public receptivity toward agriculture's reasoned demands as well as a public benevolence toward farmers were also evident.

Budgetary fruits of farm politics for 1950-59 can be shown by comparing federal expenditures for income supports of three groups: farmers, welfare recipients, and veterans.

Table 2 shows that funds for stabilizing farm prices and farm income were rapidly elevated after 1952. Even in this extremely rough compari-

Table 2. Comparison of Federal Income Support for Three Population Groups; Budgetary Outlays for 1950-59 (in Millions)\*

	Agriculture, Stabili- zation of farm prices and farm income	Labor and welfare public assistance	Veterans compensation and pensions
1950	1844	1125	2223
1951	<b>461</b> (excess)	1187	2171
1952	46	1180	2178
1953	2125	1332	2420
1954	1689	1439	2482
1955	3508	1428	2681
1956	3946	1457	2798
1957	3432	1584	2896
1958	3628	1822	3107
1959	3253	1809	3232

<sup>\*</sup> Source: Statistical Abstract of the U. S., 1957. Table No. 440, p. 365, for 1950-56. Bureau of the Budget, The Federal Budget in Brief Fiscal Year 1959.

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son farmers seem to have done extraordinarily well, considering the number of recipients involved and the extent of assistance. According to the USDA 1,290,000 farmers or the 27 per cent with annual sales of \$5000 and up received 79 per cent of the price support and stabilization benefits or an average of \$2000 per farm. In contrast, federal public assistance was given to some 5.3 million payees in 1957 (about three million receiving old age and supplementary old age assistance; 1,831,900 dependent children receiving aid; and the rest being made up by the blind and the permanently disabled). Old age assistance payments vary among the states, ranging from Mississippi's \$28.67 to Washington's \$94.15 with a national average of \$58.66 in 1957. In the same year nearly 2,800,000 veterans and 863,000 dependents of deceased veterans were drawing pensions or compensations averaging \$800 annually.

Tentatively, these figures suggest that the farmer's superior political access outweighs his lack of numbers. Behind the recipients of veterans' pensions are 22,600,000 veterans and their families; and even the recipients of public assistance numerically far outweigh farmers, especially in view of the concentration of price support beneficiaries among the minority of farmers.

Examination of unemployment insurance, which covered 72 out of every 100 workers in 1956, supports the foregoing. In 1938 unemployment insurance payments averaged 43 per cent of average earnings; in 1955, only 33 per cent. President Eisenhower requested that payments be raised to 50 per cent and that their duration (which averaged 22.5 weeks in 1955) be extended. These figures, when contrasted with agriculture's success in getting price support, surplus disposal, special credit, and other income-propping programs, strongly suggest that the 36,000,000 insured workers have been much less successful politically than the relative handful of commercial farmers—and the obvious explanation once more seems to lie in the superior location that farmers enjoy in the policy-making processes, and especially in their entrenchment in the ruling clique in Congress.

If farmers can handily call on government, it does not necessarily follow that governmental action, at least, of the kinds so far developed, have adequately met farm problems. Despite the prompt response of government after 1952, the parity index had fallen from 100 to 82 per cent by 1956-57; meanwhile, the difficulties of a number of farm programs bear notice.

Let us begin with tobacco, partly because it is vaunted as a "control program that works," being facilitated by relatively small acreages involved (currently 1,150,000 or perhaps one-third of 1 per cent of total U. S. cropland) and the fact that tobacco is marketing through relatively few outlets (thus facilitating enforcement: it is interesting that tobacco

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tively bacco produced over half the \$80 million collected in penalties from all controlled crops in 1938-1958). Even so, the program has encountered trouble, notably in burley and flue-cured tobacco (which together account for 87 per cent of both farms and acreage). Yields of both doubled from the early 1930's to the middle 1950's, demand levelled off, foreign production increased, and domestic quality fell. In spite of repeated and heavy acreage cuts, surpluses have sometimes accumulated.

The cotton program has recurrently been in trouble. When quotas were rejected in 1937 production soared to 18 million bales and created a surplus which lasted until 1946, was then reduced, then rose again so that under the formula of the 1938 law quotas were once more required. In 1950, however, a short crop and the Korean War reversed the supply situation so sharply that not only were quotas removed but exports were embargoed! Production then rose again to 16 million bales in 1953, the carryover grew, and quotas came back. Meanwhile, 40 million cotton acres in the 1920's had been cut to about 17.5 million in 1957-and an actual harvested acreage of only some 13.5 million (3 million acres had gone into the soil bank). Average yields had rocketed, but the carryover had been culled and demand was seeking higher grades of cotton. So 1958 posed its problems. The carryover was 8 million bales: enough to require the announcement of quotas; but its quality had been reduced until the more exacting foreign demand could not be satisfied, which meant that U. S. policy would once more stimulate foreign cotton production-unless quotas could be relaxed in 1958. But how to relax quotas without creating the conditions for another surplus a few years hence? And, more immediately, how to reconcile conflicting claims of the soil bank, increasingly attractive to farmers in 1958, and the need for more high quality cotton production?

Or take milk, of which marketing control is sometimes viewed as providing a pattern for other parts of agriculture; but actually the very effectiveness of this control has been measured by the considerable success of fluid markets in fencing out other dairy farmers. Of 2 million dairy farmers (over 400,000 of which are "commercial") some 180,000 in 1957 were under federal orders and they wholesaled 32,000,000,000 pounds or 31 per cent of the total whole milk sold off farms. Recurrently, westerners protest the eastern urban milk "monopolies" which they accuse the USDA of assisting. On March 20, 1958, Secretary Benson blamed the dairy marketing problems of Minnesota and Wisconsin on "restrictions imposed by cities and States—sanitary restrictions and certain controls which the States have imposed, and not controls [of the USDA]".3

Other difficulties of governmental programs could be listed-the potato

<sup>&</sup>lt;sup>3</sup> House Hearings, Agric. Approp., fiscal 1959, IV, p. 2179.

fiasco involving an outlay of over \$600,000,000 primarily because of maintenance of 90 per cent price supports in the late 1940's; and the miscarriages of the soil bank program-despite large expenditures-to take acreage out of production a record supply of feed overburdened the market in 1957-58.

There is something to be said for all these programs. Even potato supports made sense as wartime insurance against possible crop failures and actual food shortages. The tobacco and fluid milk programs have respectable admirers, as have the "ever-normal-granary" idea and the soil bank. Agricultural politics is, however, characterized by a constant frustration. On the one hand, since the New Deal stimulated and justified thorough mixing of politics and economics, farm politics has developed the political power, the skill, and-apparently also-the obligation to try to solve farm economic and social problems through government. Any single program behind which all agriculture united would almost certainly become law. Even a divided agriculture continuously secures impressive concessions from government.

But on the other hand, few farm problems get "solved." The weather. the ingenuity of non-cooperators-and of some "cooperators" as well-the uncertainty of farmers' responses, technological changes, the shifting international scene, the rise of competitive products, the sudden discovery of inelasticities in the demand for food-all these and more upset public

I conclude that farmers have great political strength which is limited, however, in the possible scope of its accomplishment, first, by the internal divisions in agriculture, second, by the risks and uncertainties involved in both production and consumption of farm goods, and, third, by the nature of the governmental instrument itself. Only the sugar beet program seems to have worked rather continuously well, and its success depends upon peculiar characteristics.4

Over-reliance upon government, e.g., by trying to support, adjust, and regulate the 20 major commodities which account for 90 per cent of total agricultural production would be administratively and politically improbable. A compounding of administrative difficulties can be predicted from projecting the numerous problems of any one of the commodity programs mod upo whe they com are ( duce invio

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<sup>&</sup>lt;sup>4</sup> The U. S. is a deficit sugar producer, hence only the domestic price need be supported. An import tax and an excise upon domestic processing yield annually 30-40 per cent more than the program costs; while without the program the USDA admits that consumer prices would ordinarily be slightly lower, the cost is apparently successfully hidden. The program is administered through a small number of sugar refining companies, who dealt in 1937 with only 68,375 payees (farmers) in continental U.S., Hawaii, Puerto Rico, and the Virgin Islands; 39,000 of these were continental beet sugar growers. (Contrast this was 806,000 commercial livestock farms, or more than 400,000 each of cash-grain, cotton, other field-crop and dairy farms-1950). Beet growers who complied with the program were paid an additional \$818 apiece in 1957, a powerful incentive for compliance.

to the whole field; for one soon learns that there are not "twenty commodities" but rather that each of these contains many subdivisions based upon differences in grade, variety, conditions under which produced, and location. The market adjusts, however, crudely, for all these refinements whereas certificates of rights to sell one's share of the commodities, if they had to be graded according to the actual differentials of value within commodities, would have to be impossibly complicated. Political obstacles are obvious in the past failures to unite all cattle producers or dairy producers behind effective control programs as well as by the well-known invidious relationship among different commodities.

On the other hand, the idea of complete governmental withdrawal from agricultural support and regulation seems both politically remote and unwise. Government programs have prevented neither a major shift of resources out of agriculture nor a tremendous exploitation by farmers of new technology. All of us can point to unfortunate governmental actions; but the remedy often lies in improving, rather than nullifying, public programs. This means that we still need to combine detailed scrutiny of farm programs, by commodities and by function, with repeated examination of the general state of agriculture and its terms of trade-all this to learn where the shifting line can presently be drawn between governmental support or control and the automatic regulation of the market so that the inevitable frustrations of the former and the inevitable insecurities of the latter may both be moderated. In the effort, however, a greater danger may breed within our very success, for it will be won by devoting to farm problems an application so intense that, in this unprecedented historical moment, the community will suffer.

#### Conclusion: The Inference for the General Welfare

The salient secular fact today is the grave deterioration of the international political position of the United States. In part the causes are beyond our control; but we should be able to make even sweeping political changes in order to focus public attention more steadily upon the major issues and to use political power to deal more effectively with them. New political forms, however, unsupported by new political ideals are useless. Central among venerable political concepts which now serve America ill is "political pluralism." Pluralism began as an answer to universalist political theories, like the oversimplification of Rousseau's "General Will" as deifying the will of the majority or like Hagel's phrase that the state is "the march of God in the world." Pluralists argued both that there were many conceptions of the good, the true, and the beautiful and also that there was in fact a distribution of power among various social entities—churches, universities, corporations, associations, and cooperatives-rather than, as universalist theories of sovereignty asserted, a concentration of power in government. Early pluralism thus rested upon a theoretical analysis of the

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preferable as well as upon an empirical study of the political facts between the decline of absolute monarchies and the emergence of 20th

Century totalitarianism.

Pluralism is often called to defend a cause which actually it serves most indifferently: individual freedom-for pluralism apotheosizes the group. DeToqueville's fears that American individualism would degenerate into egoism have been realized and compounded as the individual becomes merged in the self-seeking group. Both social psychology and political sociology have discovered their metaphysical atom in the group. What superficially seems to be an individual is merely an articulate vector of innumerable group influences. The individual is lost again in the multiplication of Calhoun's concurrent majorities. Political "freedom" is realized by any group which is able to define and defend itself, telling the rest of society, "We will make our internal laws and decide what rights, if any our own minority will have." Thus American air reverberates with plural. istic cant and American government is parcelled out among pluralistic interests-and yet the most wholesale invasion of individual privacy in democratic constitutional history has gone virtually unnoticed because it immedately galls no particular group interest. I refer to the accumulation by Congressional committees and governmental agencies of dossiers on the private lives of citizens perhaps 10 million of whom are represented in Washington files stuffed with the kind of "information" that the founders of our Constitution would have said was no business of the government.

Many farm leaders are alive to pluralistic abuses of labor and some are aware of the same faults in business; but they are largely blind to similar transgressions of their own. For agriculture is organized both as a collectivity and in its many parts to insist upon the primacy of its own interests. Political boasting that the function of the farm bloc is to get all it can for agriculture regardless of the consequences is easy to identify and to document: Congressional hearings drip with examples. But the self-serving genius of agriculture, pervasive and often subtle, emerges from the imbedding of the farm interest in the political processes and also from those going political ideas which are heavily nourished by farm politics.

The farm groups themselves, the USDA (both as a department and as an agglomeration of services, bureaus, and boards), the system of committee administration, the heavy reliance upon official referenda in price control programs, the Congressional farm bloc (itself a coalition), the adhoc approach to alliances, and the very idea of parity—all these create a profound political orientation that constrains the holder to place the special interest first and, when forced to look somewhat beyond it, to define

the larger problem in the narrowest possible terms.

What can agricultural professionals do about the cold political crisis?

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In our exacting civilization they cannot desert their specializations without abandoning their posts. But beyond this they need to promote themselves to membership in what Kurt Riezler has called "the heroes of the press." I am not advocating performance of the usual rituals. Already we have enough rustic apostles of right-wing laissez faire, keening patriotically and baiting labor, and we have fewer but still, in all conscience, sufficient green thumbs among the left-wing collectivists, cooing one-world-ishly and vilifying Wall Street. It is a hard thing to abandon one's ideological hobby horse on these intoxicating merry-go-rounds, especially when the company is so congenial. But if there was ever a time when a people were called to clear their minds of cant and to take a hard look at themselves and their institutions against the perspectives of an ominous future, this is it!

## DISCUSSION: FARM POLITICAL POWER AND THE U. S. GOVERNMENTAL CRISIS

WILLARD W. COCHRANE
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Hardin argues that the political power of farm people has not, and will not, decline proportionately to the decline in the farm population; the one party system in the rural South and the seniority system in Congress working in combination guarantee this. Farm organizations, like other organizations, can get out the vote, but they cannot deliver the vote. Networks of farm groups and related agricultural interests do influence policy, but on neither the right, nor the left, do they dominate agricultural policy. And farm interest groups are more interested in short run price-income positions than they are in world peace or constitutional reform, which might assure their survival. Very few of us would disagree with these arguments.

Some might find fault with Hardin on several minor issues, but space does not permit such a discussion here. Indeed, most criticism would focus on the statement—"Over-reliance upon government, e.g., trying to support, adjust and regulate the 20 major commodities which account for 90 per cent of total agricultural production, would be administratively and politically improbable." This statement does not represent a correct appraisal of the future, and it leads into a discussion of power relations in agriculture barely touched upon by Hardin, namely, economic power.

In observing the total political scene in the United States, certain conclusions are reached that have a bearing on this discussion. First, all of us, Secretary Benson and the Farm Bureau notwithstanding, are not going to deliver agriculture over to the free market; this is the meaning of the

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prolonged struggle over the Ellender Bill in the Senate; farm people, and city people alike, intuitively feel, where they don't understand, that such a course of action is too dangerous. Second, nonfarm people particularly and some farm people, are sick and tired of the costs involved in the farm problem; they want to find a way of greatly reducing the out-of-treasury costs of farm price and income support programs; this is the meaning of the defeat of the Cooley Bill in the House. Third, farm people and nonfarm people as well have been and continue to be hopelessly confused with respect to the key forces and relationships in agriculture; to borrow a phrase, they have been living the myth of a self-adjusting, or easily adjusted, agriculture. Fourth, an increasing number of farmers, particular larly the larger more articulate farmers, are coming to the conclusion that they must find a way to adjust supplies to demand, year after year (i.e., control supply on a permanent basis); this is the meaning of the often awkward attempts at "self-help" in the past several years. Farm people may not as yet know how to put their own house in order through supply controls, but they are trying hard to learn.

Now if farmers live in a world where collectively we are too wise to cut them adrift on the wide sea of competitive behavior, but where we feel impelled to cut program costs, where the demand elasticities are low, and where a production revolution is in process, what are farmers to do? They are forced in the direction of supply control. With the blessing of the rest of us (i.e., with the aid of enabling legislation) they must find a way to adjust supplies to demand in the principal commodities, year after year. Collective farmer action in this direction may not be smooth, or even wise; but farmers will take this course of action, because in reality they have

no alternative.

To this point this discussion of economic power in agriculture, as evidenced by the ability of farmers to withhold supplies from the market, has been concerned with appraisal of the realities of the forces involved and the probable developments. But what can we say about the desirableness, or rightness, of a course of action aimed at increasing the market power of farmers through the use of devices to control supply? Economists have traditionally given the answer that this is bad. It is bad because it leads away from the concept of a perfect market, hence away from a "demonstrable" optimum allocation of resources, hence to inefficiencies in production and the payment of returns to factors not consistent with their marginal value products.

Gaining of market power by farmers through the exercise of controls over supply may lead to something bad; it has in such instances as the medical profession, the plumbers, and the crude oil industry. But all the "rightness" does not rest with the perfect market argument for agriculture.

It does not for at least two reasons:

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First, the achievement of an optimum allocation of the conventional productive resources makes a lot of sense in a static economy; with a given set of resources it is the only way that output can be increased. But in a dynamic economy where technological advance is rapid and widespread, bordering on a revolution, the achievement of an optimum allocation of a given set of resources is largely irrelevant. Output, in practice, is increased through the adoption of new techniques. The only relevant allocation problem in this situation is the allocation of research and development resources. But to date little that is intelligible has been done with respect to this larger allocation problem. It is simply assumed in agriculture that the more resources devoted to research and development in agriculture, the better. I assert this is a strange world; economists spend untold hours fiddling with roughage-grain substitutions and laborcapital substitutions on farms these days, and no one analyzes the machine that makes the modern economy go-namely, the allocation of resources devoted to research and development among sectors of the economy. In sum, the conventional argument of the need to return to a perfect market in agriculture to achieve an optimum use of regularly employed resources to in turn increase output and increase living standards has in fact lost all contact with reality.

Second, even if all the paraphernalia of price and income support and production controls at both the federal and state levels were pulled out of agriculture, the economy that remained would not be a free market economy. It would be a purely competitive economy with the rest of society intervening with respect to the support of research and development and the extension of new methods to producers. It would be a free market economy with the engine of technological advance left running. To such technological intervention each farmer would have to adjust by adopting new techniques as fast as he could. This adjustment by all farmers would increase aggregate output, and, to the extent that it exceeded demand, the farm price level would have to fall. And to the extent that all of society decided to help the poor farmer out some more by further increasing the allocation of research and development to agriculture, each individual farmer would have to make further output increasing adjustments. In sum, this is not a free market—it is a nonfarm dominated market wherein technological advances are passed through the farmer in a covert policy of low food prices for consumers.

In summary, then—remember (1) that the purely competitive criteria as applied to agriculture is deceptive and (2) that policy formulation and execution in the domestic economy is primarily concerned, as has long been the case in international affairs, with balancing power. This may not be comforting to you, but you had better give it serious thought as you set out to ring doorbells with your basket of policy advice.

# SOCIAL SECURITY FOR FARM OPERATORS: ACCEPTANCE AND ROLE IN FARM POPULATION ADJUSTMENT

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JOHN C. ELLICKSON
Agricultural Research Service, USDA\*

THE enactment and acceptance of the social security program reflected a fundamental change in the value judgments of the Ameri-

can people.

What was the nature of this radical change? What brought it about? Why didn't farmers express themselves in favor of coverage by old-age and survivors insurance? Why were most of them willing to qualify for monthly benefit payments when the law was finally amended to include farm operators? What effect will the program have in helping farmers adjust to the effects of rapid technological change? These are the kinds of questions with which this paper is concerned.

The term "social security" includes a variety of insurance and assistance programs, but attention in this paper is centered on Title II of the Social Security Act, which now includes old-age, survivors', and disability insurance. No attempt will be made to describe the general development

of the program or its technical details.1

Indigenous to the American tradition is the value judgment that the individual<sup>2</sup> is and should be responsible for doing all he can to provide for his own economic security through his own thrift and industry. This

judgment has not changed.

But there has been a fundamental change in judgments concerning the proper locus for responsibility for individual security and the appropriate means of meeting this responsibility. Until the 1930's, all sections and levels of American society were predominantly of the conviction that responsibility for protection against personal economic hazards resides in the individual. During the depression of the 1930's, this older judgment gave way to a new conviction that responsibility for individual security was the joint obligation of the individual and his political community.

constructive criticisms in the development of this paper.

<sup>1</sup> For a short history and description, see "Social Security in the U.S.," Social Security Administration, Washington, D.C., 1948. Also, "Old-Age, Survivors, and Disability Insurance: Development of Agricultural Coverage," U. S. Dept. Health, Education and Welfare, Social Security Bul. Vol. 21, No. 6, Washington, D.C., June

1958.

<sup>\*</sup> The opinions expressed in this paper are those of the author and do not necessarily represent the views of the Farm Economics Research Division, Agricultural Research Service, or the USDA. Appreciation is extended to John M. Brewster, of the Farm Economics Research Division, Agricultural Research Service, and to Roy L. Roberts, Bureau of Old Age and Survivors Insurance, U. S. Dept. Health, Education and Welfare, for constructive criticisms in the development of this paper.

<sup>&</sup>lt;sup>2</sup>Throughout this paper, the terms "individual" and "family," in a broad sense, are used interchangeably.

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The new sense of social responsibility for the individual's economic security, however, has included and conserved the essential spirit of individual responsibility inherent in the older philosophy. This basic sentiment was reaffirmed by the President in his social security message of January 1954, in which he declared that the old-age and survivors insurance system had been developed in response to the need "arising from the complexities of our modern society. . . . The system is not intended as a substitute for private savings, pension plans, and insurance protection. It is, rather, intended as the foundation upon which these other forms of protection can be soundly built. Thus, the individual's own work, his planning and his thrift will bring him a higher standard of living upon his retirement, or his family a higher standard of living in the event of his death, than would otherwise be the case. Hence the system both encourages thrift and self-reliance, and helps to prevent destitution in our national life."

To overlook the fact that the new sense of social responsibility thus includes and conserves the essential spirit of the older values of individual responsibility is to see only the discontinuities of history and to lose sight of its continuities.

Another often overlooked fact is that within an economy of predominantly family units of production the older ethic of individual responsibility rested on a high degree of social intelligence and realism. In such an economy, firms and households are identical and the individual's thrift and industry meet a double need. On the one hand, they are the source of his increasingly fruitful employment because they take the form of the land and capital accumulations with which he works. On the other, they are the source of his future security, because these accumulations outlast his productive years, and therefore yield an income when he is no longer able to work because of age or other impairments. Therefore, to be without adequate means of livelihood in his later years was "merely evidence of a misspent life." For these reasons, in an economy of family production units to have the state share the individual's security burden would have weakened rather than strengthened his sense of personal responsibility.

Conceivably, the same degree of personal responsibility and devotion to thrift and industry, which was sufficient for one's security needs in the older economy of family production units, could well lead to unbearable insecurities in the machine age in which identities of firms and house-

<sup>&</sup>lt;sup>3</sup> This part of the President's message is quoted from "Old-Age and Survivors Insurance after Twenty Years," by Victor Christgau, U. S. Dept. Health, Education and Welfare Social Security Bul. Vol. 18, No. 8. Washington, D.C., August, 1955.

<sup>&#</sup>x27;See paper "Technological Advance and The Future of the Family Farm," by John M. Brewster, given at this meeting.

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holds are lost. There is no reason to assume that people lost the desire for doing all that could be done to meet their security needs as a new economic environment arose. But the farmer was slower than the industrial worker to question the belief that individual thrift and industry were sufficient to meet personal security needs. This "farmer viewpoint" dominated national legislation until the 1930's. As late as 1929, nearly all public relief was paid from local funds by villages, towns, and counties. The state's chief responsibility for public welfare was to provide care in institutions for mentally sick or defective persons.<sup>5</sup>

The depression of the 1930's precipitated two fundamental changes in popular thinking that are relevant here. First, the savings of millions of people were wiped out through unemployment, bank failures, and mort gage foreclosures. No longer able to support themselves and with little prospect of finding another job, many older persons were in desperate need through no fault of their own. They could see no end to the depression and were deeply concerned about job opportunities for their children. In this situation, they provided a receptive audience for the exposition of a variety of economic panaceas, which usually centered around generous weekly or monthly payments to all retired senior citizens. Second, with the near bankruptcy of many local governments, most people turned naturally to the federal government as the only agent that could help them.

Stimulated by the popular appeal of demagogic schemes for payments to the aged, responsible students of the problem accelerated the development of workable plans for protection against the more obvious economic hazards. The same appeal weakened opposition and the first Social Secur-

ity law was passed in 1935.

Even at this comparatively recent date, farm thinking on old-age insurance continued to lag behind that expressed in the cities. For example, farm spokesmen did not oppose social security for industrial workers, but continued to assume that if farmers could only get a fair price for their products, they would be able to take care of their own security needs.

In translating the new idea of social responsibility for individual security into law, care was taken to conserve the essential aspects of the older value—that each individual is and should be responsible for doing all he can to provide for his own economic needs. For example, Title II of the original Social Security Act authorized a compulsory, contributory oldage insurance system with a trust fund to which the covered employee and his employer would make joint contributions during his working life and from which benefit payments would be made after he had attained age 65 and retired. So far as possible, the amount of the benefit payment

<sup>5</sup> Social Security in the United States, 1948, op. cit.

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would be proportional to the amount of taxes contributed. Each worker (or his estate) would at least get his money back from the system, and each was to get at least as large a monthly retirement payment as the amount of his contribution would buy from a private insurance company. The integrity of each worker's proportional share in the trust fund would be preserved. A government appropriation was authorized when necessary in the future to offset the cost of payments to older workers who would retire soon after 1941 and who had been contributing for too short a time to pay the total costs of their own benefits.

The old-age insurance system began operating in 1937. Experience soon demonstrated that the initial emphasis on the individual account of each insured worker had defeated the major goals of the program. In 1939, the Social Security Act was amended to extend protection to the families of insured workers by authorizing benefit payments to survivors and dependents.

The wage records of insured earnings, as reported under social security, indicated less occupational stability than had been expected, and the inequities resulting from incomplete coverage became obvious. Wage workers sometimes went into business for themselves and thereby lost their insurance protection. Especially in rural areas, many individuals held several different jobs during a year, only some of which were in covered employment.

A few individuals would have qualified for benefit payments after contributing only a small amount to the system, but many more would have received nothing after making substantial contributions.

The original intent that old-age insurance would eventually replace old-age assistance began to be realized in urban areas, but to only a small extent in rural states. After 13 years' experience, more aged persons were receiving more money in the form of welfare pensions than were receiving insurance benefits as a matter of right.

But by 1950 the idea of social insurance had become generally acceptable. The amendments in that year to the Social Security Act further recognized the need for a system of universal coverage that would reduce inequities. More occupations were covered, including most of the nonfarm self-employed and regularly employed hired farmworkers.

It was not until the beginning of 1955 that farmers were included in the old-age and survivors insurance program. The Congress was attempting to extend coverage to all possible occupational groups in order to avoid the inequities that arise from incomplete coverage. So the chief demand for covering farmers came from sources other than the farmers themselves.

Farmers were brought under the program with some trepidation. When the bill passed the House, it provided for covering farm operators, but

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this provision was deleted in the Senate. The Senate members of the conference committee expressed concern that the apparent lack of interest on the part of farmers in obtaining coverage for themselves might change to active opposition if the House provisions were retained in the law. It is said that only a negligible number of letters, some of which were against coverage, had been received from farmers on this issue. The Farmers Union favored the inclusion of farm operators, the Grange favored optional coverage; and the Farm Bureau opposed compulsory coverage of farm operators.

A way out of this dilemma was proposed by a member of the conference committee, who pointed out that farmers would not pay the self-employment tax on their 1955 earnings until January 1956. If it developed that many farmers were opposed to coverage, there would be ample time to repeal that part of the law in the next session of the Congress. With this safeguard, the House provision was retained.

Opposition by farmers to coverage did not develop as had been feared. Evidence to the contrary is indicated by the fact that the 1956 amendments to the Social Security Act extended coverage to some landlords and to very low-income farmers who were not covered in the 1954 amendments.

Why did farmers finally accept coverage by old-age and survivors insurance? Because of their belief in the older values of complete personal responsibility, farmers could not participate in the development of new methods for attaining economic security through social action. But accepting the new institutional arrangements for themselves after they became law was another matter, for several reasons.

In the first place, farmers, like other people, do not want to be considered too "different" from other members of our society. For nearly 20 years, most farmers had had friends or relatives who were covered by old-age and survivors insurance and in recent years many farmers had been covered through off-farm employment. This familiarity with the operations of the system was increased after 1950 when regular hird farmworkers were covered and several hundred thousand employers filed returns on their farm employees. A similar experience had been important in creating a demand for nonfarm self-employment coverage.

Another indirect, but powerful, influence was the pressure of technological advance on the economic position of most older farmers. Many were unable or unwilling to compete with larger farmers for the rental or purchase of additional land, or to buy more efficient equipment and thus meet higher production and living costs. Subsistence farming or the sale of cream from a few cows and eggs from a farm flock became a less

<sup>&</sup>lt;sup>6</sup> See second reference, footnote 1.

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feasible means by which an older farm couple could support themselves. A relatively large and increasing proportion of applications for old-age assistance had come from rural counties. These and other pressures had the effect of increasing the concern of many farmers about their own old age security.

Finally, the farmers saw a vast difference between asking for a "handout" and complying with the law on the same basis as most other Americans—whether business proprietors or wage and salary workers. By 1957, the lingering doubts of some lower income farmers about the propriety of accepting old-age and survivors insurance benefits were lessened when they learned that some of the more productive farm operators in their community were receiving monthly benefit payments.

Data on farmer participation indicate change in individual value judgments better than do data for any other occupational group in the oldage and survivors insurance system. In each year, several hundred thousand farmers may choose whether or not to pay the social security tax and earn coverage. This choice is open to farmers with net self-employment incomes of less than \$400 and gross farm incomes of \$600 or more in tax years after 1955. In contrast, the tax payment is compulsory for most other occupational groups including the nonfarm self-employed group. Employers of nearly all wage and salary workers in covered employment deduct the employee's share of the tax from his pay, add an equal amount, and forward it to the Internal Revenue Service. No action is required from the worker.

Attention is now directed to the extent of farmer participation in the old-age and survivors insurance program. The concern here is with three main questions: How many farmers have contributed to the program by paying taxes on their self-employment income? What proportion was this of all farmers who might have paid the tax? How many farm operator families are now receiving benefit payments from this program?

Most of the statistical information available that relates to these questions is obtained as a byproduct from the accounting and operating reports of the Bureau of Old-Age and Survivors Insurance. The frequent shifting of workers from one occupation to another has made it practically impossible to classify beneficiaries on the basis of the occupations in which they earned the social security credits that permitted them to qualify for social security payments. Consequently, the Bureau makes no attempt to separate farmers from other occupational groups. But when the available data are combined with information from other sources, they provide a base from which it is possible to make estimates that will serve our purpose.

Preliminary estimates from the Bureau of Old-Age and Survivors Insurance indicate that about 2.5 million individuals paid social security

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taxes on their 1956 self-employment income from agriculture, the latest year for which data are available. The corresponding number for 1955 is about 2.3 million. This net increase of about 200,000 in the number of tax returns, which occurred at a time when the number of farms was declining, probably arises largely from the increased coverage provided by the 1956 amendments, which extended coverage to certain "materially participating" farm landlords and also to some low-income farmers who were not covered in 1955.

Also indicative of farmer acceptance of social insurance is the fact that the number of farm income tax returns increased by nearly 300,000 between 1953 and 1955, when farmers first had opportunity to participate in social security. This was about 8 per cent more farm business returns than for any previous year of record (Table 1).

Table 1. Number of Farm Business Income Tax Returns for Selected Years, 1939-531

Year	Sole proprietors of farms	Farm partnerships	Agricultural corporations and services	Total, all farm returns
	1,000	1,000	1,000	1,000
1955	3,417	2	9	•
1953	3,126	135	9	3,270
1951	3,139	2	8	
1949	2,987	2	7	
1947	2,904	114	7	3,025
1945	2,659	97	6	2,769
1939	140	37	8	185

<sup>1</sup> From Statistics of Income Parts 1, 2, and 3, Internal Revenue Service, for corresponding years. For 1955, includes less than 20,000 returns from outside the continental U.S.

<sup>2</sup> Not available.

<sup>3</sup> The increase in number of returns to 1945 was due mainly to lower income filing requirements and the introduction of the withholding tax. The continued increase in number of returns to 1951 presumably was due largely to higher prices and increased production.

Available data from the Current Population Series Consumer Income Study for 1955 indicate that probably about 3 million individuals had \$400 or more net earnings from farm self-employment during that year. This figure makes no allowance for the option given farmers to base their net earnings on their gross incomes or to report their actual net earnings. A precise comparison between this estimate of the number of farm operators who might have paid the social security tax and the number that did pay it for 1955 is not possible because of differences in concept and definition. An adequate analysis cannot be made until additional data are available.

Available data also indicate that about a half-million families are receiving benefits based entirely or partly on farm self-employment earnings.

At this point, I would like to direct attention to old-age and survivors

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insurance for farm operators as a way of attacking the low-income problem in agriculture. As all of us know, a wide gap exists between the earnings of individuals in farming and the earnings of those in nonfarm employment. This gap is reflected in the fact that the median earnings of semiskilled workers in nonfarm employment was about \$4,500 in 1955,7 as compared with the average net income from farming of approximately \$2,000 for the same year.8

Farm people are trying to lessen this income gap; some by shifting to nonfarm occupations and others by enlarging their farm units. For example, from 1939 to 1954, the number of commercial farms decreased by nearly 1.2 million, or by 27 per cent.<sup>9</sup> By and large, neither of these methods of raising the general level of farm income is open to farmers aged, say, 55 years or older. At this age, the earning power of their skills is typically no greater in nonfarm occupations than in agriculture. Also, most of them are unable or unwilling to take on the substantial burdens and risks of farm enlargement. Thus, the two main methods of raising the level of farm incomes are virtually closed to more than a third of the operators of commercial farms.<sup>10</sup>

Old-age and survivors insurance will improve the economic well-being of older farmers who are able to meet the minimum gross income requirements, and more will reach retirement age each year. The benefit payments may be small, but they are certain. With this assured income as a base, older farmers have more alternatives to choose from in managing their financial affairs. About two-fifths of all farmers who paid the self-employment tax for 1955 and 1956 had net incomes of less than \$1,200. They were thus able to continue at the same level of operation and to receive all of their benefit payments. Some farmers may decide to rent out all or parts of their farms to neighbors or place them in the conservation reserve. The senior member of a farm partnership may decide to turn over the responsibility to the junior member, who is usually a son or son-in-law.

Some operators may leave farming entirely and move to town or a warmer climate, but I suspect that these will be the exception. Most farmers, like other people, apparently prefer to live on in the familiar home and among friends. But they tend to slow down as they grow older, and with some assured income they will not be forced to work beyond

<sup>&</sup>lt;sup>7</sup> U. S. Bureau of the Census, Family Incomes in the United States, Current Population Report P-60, No. 24, Table 8, Washington, D.C., June 1957.

<sup>&</sup>lt;sup>8</sup> U. S. Agricultural Marketing Service, Farm Income Situation, Washington, D.C., July 1958.

Jackson V. McElveen, Family Farms in a Changing Economy, USDA, Agr. Inform. Bul. 171, Table 4.

<sup>&</sup>lt;sup>10</sup> U. S. Bureau of the Census, General Report, Volume II, 1954 Census of Agriculture, Washington, D.C., 1956. Table 18, p. 974.

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their strength. One visible effect of old-age and survivors insurance  $m_{\rm ay}$  be to reduce the number of commercial farms reported by the 1959  $C_{\rm ell}$ -sus of Agriculture.

In 1956, the Social Security Act was amended to authorize benefit pay, ments to totally and permanently disabled workers who had attained age 50 and had contributed to the insurance program for 5 of the 10 years preceding the onset of the disability. Older farmers who have been in the program continuously since 1955 may become eligible for this new insurance protection in the latter part of 1959.

We have indicated that farmers first looked upon social security as unnecessary and incompatible with their values. Increased familiarity with the system, directly or through relatives and friends, decreased this aversion, but farmers did not ask for this protection. When the advantages of universal coverage brought farmers into the system there were practically no objections. Farmers have now learned that acceptance of the new method can be included within their older judgment that the individual should be responsible for his own economic security. The full effect of this social change will unfold in the future, but most farmers can now look forward to a small but assured income as the foundation for a more secure old age.

#### DISCUSSION: SOCIAL SECURITY FOR FARM OPERATORS: ACCEPTANCE AND ROLE IN FARM POPULATION ADJUSTMENT

R. G. F. SPITZE
University of Tennessee

The planning personnel are to be commended for including social security as a topic in a discussion of the impacts of technology. Certainly, it is one of the most far-reaching "technologies" that has emerged in our society. So often we are prone to associate only forage choppers, hog parlor feeding, or high analysis fertilizer with the notion of technology, ignoring new modes of private or public organization as being of the same "species." Yet, any new operation, technique, or organization, encompassing dependable relationships is a new technology, a new tool for more desirable problem-solving.

Ellickson's careful study and documentation of the chronology of the social security program for farmers, the underlying causes of its development, and present status depict the high quality of analytical work for which he is known. I would like to direct my observations, in the limited time I have, to three specific aspects of Ellickson's paper. My comments

are meant to be an elaboration and possible further clarification as I see it on some issues, very crucial to economic analysis. These points are: (1) the fundamental continuum of public value judgments in this country and others having a democratic or representative type of government; (2) the relationship between private interests and public policy with particular reference to Social Security for farmers; and (3) further consequences

expected of this program in population adjustment.

First, I heartily agree with the author's succinct statement, "To overlook the fact that the new sense of social responsibility thus includes and conserves the essential spirit of the older values of individual responsibility is to see only the discontinuities of history and to lose sight of its continuities." An adequate theory of political action and of governmental economic action in a democratic society would seem always to make social responsibility dependent upon individuals or private groups. Certainly one of the most important premises of our political system is the respect for the maximum possible and desirable opportunity for individual action and, furthermore, the dependence of the individual upon the consequences of these actions. However, probably of equal importance is the premise that individuals may seek and use unreservedly the tool of public action to achieve some of their ends. If we negate this, we would be still guarding our own property with sticks and stones, respecting no limited liability or contractual responsibility in any economic transaction, and receiving that information dictated by the press or rostrum with the greatest physical power. Public policies or any governmental actions in a democratic society seem to emerge when new understanding, change in physical proximity of individuals through population concentration, or alteration in environment affects the desire of enough individuals to organize things differently.

Now, the point I want to emphasize is that wherever you find societies with governments representative of many individuals or interests as distinct from a government of a few individuals or of identical interests, then you find public action preserving these values and responsibilities of the individual. In reality, public action becomes the instrument of individual responsibility. Yet, the form has changed repeatedly and would be expected to continue to do so. For, example, the expropriation of the lands of the Tory sympathizers, the Bill of Rights, eminent domain, railroad land grants, the tariff, the National Farm Loan Act of 1916, Agricultural Adjustment Agency of 1938-all symbolize the process of individual and private action being transformed into public action and social responsi-

bility.

Social security for farmers is simply another example in this continuum. Why it was developed for this generation instead of earlier is probably due to the depression, the work of the program specialists, new ways of

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farming—all well described in Ellickson's paper. But, even though the form of individual and public action is not the same after the enactment, surely the basic principle, purpose, and nature of governmental action has not been altered. Here is the continuity, as I understand it, to which Ellickson refers.

However, I am not sure, then, what he meant by repeatedly emphasizing that social security ". . . reflected a fundamental change in the value judgments of the American people" or that social security preserved the older value—"that each individual is and should be responsible for doing all he can to provide for his own economic needs." Surely, the fundamental value judgment of American people from the very beginning, i.e., that their government is responsible in its action to their desires and welfare, has not changed. Neither does it seem accurate to say that individuals are still responsible for doing all they can when a substantial number of the current farm operators will qualify for social security and receive benefits far in excess of their contribution, regardless of their resources.

The second point of attention is the role of farmers in securing and accepting social security. Documentary evidence seems to support well Ellickson's contention that farmers did not press for their own coverage. Although I would contend that a public policy found acceptable by an interest group, such as farmers, generally is proposed and fought for by such a group, some policies seem to result from advantages accruing also to other interests. I would suggest, in view of the average age of farm operators and the acceptance which they have shown to social security, that their initial indifference and seeming hostility were more a matter of ignorance than opposition to an understood policy. We see this repeatedly in other areas such as the verbal blasts from farmers about governmental acreage control followed by continued affirmative referendums when the issue is really faced.

Thus, I wonder whether the events are clearly explained by Ellickson's statement: "Because of their belief in the older values of complete personal responsibility, farmers could not participate in the development of new methods for attaining economic security through social action." I doubt that their belief in the relationship of individual to government changed, but I believe their understanding of a new, complicated policy and technology did.

Finally, a comment on the consequences of social security in population adjustment, with reference to the capital problem. As Ellickson indicates, any population effects are likely to be slow in appearing. Also, it might be added, capital and population shifts seem to be integrally related.

The increasing capital needed for efficient farming and the continued difficulty faced by each farming generation trying to accumulate that capital seem evident from many sources. I believe social security can

tend to assist here to some extent on two counts. The aversion many farmers have to risk-taking is well known, as is the necessity for taking some risk in establishing a profitable business operation. From a study we are making in Tennessee, it was found that some farmers believe that those who do not use credit are better farm managers than those who do; furthermore, 25 per cent would be unwilling to borrow even with expectation of profit if they had to give a chattel mortgage, and 40 per cent would be unwilling borrowers if a real estate mortgage were involved. The secure minimum income afforded at retirement to the operator and to his survivors by social security may remove some of the fear now interfering with more profitable use of additional sound credit on many of our farms, particularly in the South.

Then, too, there is the disheartening sequence of old age, reduced operation, estate settlement, and replenishment of the farm investment that so disrupts the capitalization process in farming. It is entirely possible that with the added retirement and survivor's income assured by social security, older farmers will be more willing to release their productive capital which represents accumulated assets, and lend, rent or sell it to other operators. Such a propensity for transfer earlier in the life of many of our elderly farmers could surely conserve some capital already in agriculture

and speed the process of increasing the amount used per farm.

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Chairman: Harry A. Steele, Agricultural Research Service, USDA

#### PLANNING AND EVALUATION\*

JOHN KRUTILLA Resources for the Future, Inc.

HIS paper will take up recent progress in economic planning and evaluation of water resources programs with special application to international streams, with "recent" meaning since 1952-53. This will be our point of departure for two reasons. First 1952-53 marks roughly the end of a period during which-at least in the United States-the principal evaluation procedures were those developed in the familiar "Green Book" and the original draft of "Circular A-47." It was the beginning of a period of greater emphasis on reducing public works expenditures and on analyses directed toward maximizing an objective function subject to budgetary constraints. Moreover, maximization subject to side conditions appears to be particularly appropriate where program formulation involves investments in more than one political jurisdiction, as in the case of international streams. The second reason is that the results of this new line of inquiry are not yet at the publication stage or else have just been published and thus may not be familiar to those who have not been touched directly by the ferment of activity the new emphasis has fostered.

## Efficiency Investment Criteria for Public Expenditures

Although some awareness of budget constraints appeared in embryonic form in the "Green Book" and elsewhere,4 the first systematic attempt at incorporating side conditions appropriate to the constraint appear in the work of McKean<sup>5</sup> and Eckstein.<sup>6</sup> Both draw more explicitly from the cor-

Acknowledgment is due Otto Eckstein, Julius Margolis, Roland McKean and Peter Steiner, for reviewing an earlier draft of this paper. The author is also indebted to Kris Kristjanson, John Peterson, Mark Regan and Gene Weber; and to his colleagues at Resources for the Future, principally Irving Fox, Henry Jarrett, Herbet Mohring and Dick Muth; for helpful comments and suggestions. The views expressed are those of the author and do not necessarily repersent the views of either the individuals who have offered helpful suggestions nor the organizations with which they are affiliated.

Proposed Practices for Economic Analysis of River Basin Projects, Report to the Federal Inter-Agency River Basin Committee, prepared by the Subcommittee on Benefits and Costs, 1950.

<sup>&</sup>lt;sup>2</sup> Bureau of the Budget Circular A-47, Executive Office of the President, Washing ton, D.C., December 3, 1952.

\* Proposed Practices, op. cit., p. 14.

Regan and Timmons, op. cit., p. 5. <sup>5</sup> Roland N. McKean, Efficiency in Government Through Systems Analysis, with

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pus of welfare economics than do the earlier efforts. Both assume a restricted budget insufficient to undertake all the projects where the gains exceed costs as determined by prices in factor markets, and criteria to guide allocation of a limited budget efficiently within the water resources field, subject to this constraint, are developed. The resulting criteria nonetheless vary somewhat owing to differences in judgment on the appropriate discount rate to be used for planning purposes and on whether the constraint applies appropriately to capital or to total budget expenditures. The problem is conceived basically as maximizing gains for a stipulated outlay. McKean proposes selecting projects that provide the maximum present value. The net benefit streams (the annual gross benefits less annual operation and maintenance costs) are discounted by that rate which will equate the present value of the marginal project to its capital costs, subject to the condition that total investment just equals the capital ration. The appropriate rate, accordingly, is determined by the rate of return on the marginal project and all projects' marginal increments, permitted by the capital ration. Where project interdependencies pose difficulties, Mc-Kean suggests examining interdependent projects iteratively to find that combination of projects and scale for which the present value of the net benefit stream is maximized, consistent with the capital ration.7

Eckstein's approach differs by virtue of his assumption that the total budget expenditures, rather than investment funds alone, are subject to the constraint, and through his use of a social time preference for planning purposes. In this, he follows more closely the conventional benefitcost procedures in that he develops an investment criterion which seeks to maximize the present value of the difference between gross benefits and total costs (original investment plus the sum of the discounted stream of annual operation and maintenance outlays-O and M costs). He incorporates a social discount rate for planning purposes (2.5-3.0 per cent) which reflects the prevailing political consensus and can be interpreted as a social time preference, along with a minimum benefit-to-cost cut-off point to insure that the restricted budget is employed so as to maximize the net gains for the stipulated budget. With a sufficiently restricted expenditure ration, the minimum benefit-to-cost ratio serving as the cut-off point would result in a smaller water resources development program than necessary to equalize the social marginal productivity of resources in the water-resources and private sectors.8 With a more adequate budget, the cut-off point is

Emphasis on Water Resources Development, New York: John Wiley and Sons, Inc., 1958.

<sup>&</sup>lt;sup>6</sup>Otto Eckstein, Water Resources Development, The Economics of Project Evaluation, Cambridge: Harvard University Press, 1958.

McKean, op. cit., pp. 86-87, 89-91, 98-99, 122.

<sup>&</sup>lt;sup>8</sup> This observation is equally true for the McKean criterion, where the social marginal productivity of capital in the water resources applications (if the constraint is effective) will exceed the social marginal productivity in the private sector.

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determined so as to equalize the social marginal productivity of water resources expenditures and the opportunity cost of resources drawn out of private employments. If the social time preference is, as assumed, less than the opportunity cost of public funds, the resultant benefit cost ratio,

of course, would still have to exceed unity.9

The decision as to whether the constraint applies to investment funds alone, or to the total budget ration for the planning agency, is not a simple one. McKean argues that nonmarketable project benefits can be regarded in some sense as current receipts from the nation's standpoint.10 Although the rationale is not made explicit, presumably they may appear ultimately in the tax base and thus be reflected in the Treasury's revenues to lessen somewhat the effective constraint. At any rate, he feels there is no justification for ignoring the revenue receipts from marketable project services in determining to which funds the constraint applies. Since the efficiency investment models are all developed to guide resource allocation under conditions of full employment, however, resources not otherwise used in the water field would find alternative employment and generate equivalent taxes elsewhere. The situation for receipts from marketable project services is perhaps more complicated. For example, a large part of the benefits from the Corps of Engineers' projects are nonmarketable, while power from the Corps' projects is marketed by one of the several Interior Department power-marketing agencies. Such receipts will go to the general fund of the Treasury rather than appear as available for offsetting current O & M costs of Corps programs. On the other hand, some of the O & M costs of Bureau of Reclamation irrigation projects are met by advances from water users; others in some cases are met by Congressional appropriations, albeit from the Reclamation fund; while still others, those allocable to flood control and perhaps other nonreimbursable project purposes, must be met out of the budget ration. Accordingly while there is greater justification for regarding the constraint as applying to capital alone in the case of the Bureau of Reclamation, the McKean formulation of the investment criterion, if required of all agencies, would make the Corps' program largely inoperable.11 If for political reasons only one form of criterion is to be employed uniformly by all of the public agencies in

<sup>10</sup> McKean, op. cit., pp. 114-116.

<sup>11</sup> Actually, McKean's investment criterion abstracts from existing institutions. It is designed for dealing with the total investment budget subject to Congressional discretion. Thus while the form of criterion may be correct if one abstracts from the agencies through which the investments are actually made, it would not be universally applicable in the absence of a pretty fundamental reorganization of governmental agencies and procedures.

<sup>&</sup>lt;sup>o</sup> Eckstein computes a sample set of benefit cost ratios, on the assumption the social time preference ranges from 2.5-3.0 per cent, required to ensure that marginal productivity of resources in the public sector are at least equal to the yields foregone from private alternatives.

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nal discom the univergovernthe water resources field—or by the review agency in evaluating projects submitted to the Congress in the President's budget—the Eckstein formulation appears to be the preferable compromise. On the other hand, it does appear conceivable that political sanction could be obtained for use of different forms of the investment criterion appropriate to the different circumstances, with respect to current receipts and outlays, that are faced by different agencies.

Shortly following the appearance of the McKean and Eckstein studies (in manuscript form, spring 1955) Margolis addressed a similar or related problem. <sup>12</sup> I believe that he perceived a situation involving multiple constraints, each attaching to a separate component of complementary investment opportunities. Thus it seems to me that he addresses a problem of this nature: given a federal irrigation project justified by benefits received by private farmers and requiring associated investment on the land by them to utilize the developed irrigation water supply, what discount rate should be employed when (1) the farmers encounter capital rationing, and (2) the relevant public agency's budget is fixed by political considerations?

Margolis assumes that the total federal budget is fixed by considerations stemming from counter cyclical fiscal policies. He therefore argues there are no opportunity costs normally associated with yields foregone by diverting resources out of the private sector.<sup>13</sup> Moreover, he regards the budget allocation to the development agency in question as politically determined, and hence argues that there are no genuine benefits foregone from otherwise possible alternative applications in the public sector.<sup>14</sup> Given these circumstances he attempts to provide a rationale for applying the internal rate of return to farmers as the appropriate rate with which to discount the stream of net benefits from the public irrigation project.

Discounting the *net benefit* appears justified, in view of Reclamation Bureau's covering of current outlays with current receipts. As to the rate advanced for discounting, I believe it provides a solution for an unrealistic problem. On the one hand, if the government expenditures are determined by federal counter cyclical policy, is it meaningful to discuss the question in terms of a benefit cost efficiency criterion? On the other hand, if the problem is perceived as one of allocating scarce resources, implicit in the form of criterion developed, the resources drawn out of private employments have an opportunity cost. Within the context of the latter interpretation there would then be two opportunity costs: one given by the yields in the private sector precluded by the public use of productive resources in the irrigation project; and one given by the internal rate of return of

Margolis, op. cit., p. 10.

" Ibid., p. 10.

<sup>&</sup>lt;sup>12</sup> Julius Margolis, The Discount Rate and the Benefit-Cost Justification of Federal Irrigation Investment, Department of Economics, Stanford University.

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farmers for the associated private investment in complementary irrigation facilities. The two rates would be identical only if the funds for the public project could be conceived as diverted from the capital ration in the agricultural sector; or, alternatively, if one relaxed the Margolis assumption that sub-allocations among public programs were not given by political determinants and that such funds could be diverted alternatively to increase the agricultural capital ration.<sup>15</sup>

In the absence of these possibilities, the approach recognizing multiple constraints does not differ in principle from the approach advanced in the Green Book for multiple discount rates where opportunity costs differ between two parties to complementary investments. <sup>16</sup> It does serve to focus attention on the implications of imperfections in the capital market for program formulation and project evaluation. For this, Margolis should be enthusiastically commended.

## Criteria for Evaluating "Partnership" Proposals:

Accompanying the emphasis on reducing the expenditures of the federal government in the United States following 1953, has been a parallel effort in the water field directed toward involving private interests more fully in developing river basin projects. In response to this political development, Krutilla and Eckstein have developed a model which, unlike the efforts treated immedately above, does not address the question of allocating a public budget optimally but rather the question of criteria required for evaluating the comparative efficiency of federal and partner ship plans for development.17 Taking explicit account of the divergence between private and social product of investments in the water field, they develop a model for comparing the net social product under federal and partnership plans of development for a number of partnership proposals. No budgetary constraints were assumed in order that the opportunity cost by which the federal plans of development were evaluated, in relation to the partnership plans, would not be raised artificially over the marginal productivity of resources drawn out of private employments. That is, the model short-circuits the possibility of arbitrarily disqualifying a public project by an "irrational" budget constraint.

This study assumes that if a project were undertaken by the federal government, resources would be siphoned out of the private sector by means of federal taxation, rather than being undertaken at the expense of

<sup>&</sup>lt;sup>15</sup> Margolis along with McKean abstracts partly from the institutional environment, considering a land and water resources development budget subject to Congressional allocation, rather than the appropriate portions of the Departments of Agriculture and Interior budgets.

<sup>&</sup>lt;sup>16</sup> Proposed Practices, op. cit., pp. 22-24.
<sup>17</sup> John V. Krutilla and Otto Eckstein, Multiple Purpose River Development, Studies in Applied Economic Analysis, Baltimore: The Johns Hopkins Press, 1958, Chapter IV, V and VI.

other public uses. It assumes that in the absence of undertaking a given federal project, federal taxes could be reduced by an equivalent amount. Two tax changes are postulated; one favoring relatively the lower income classes and consumption; the other, the higher income groups and investment. The economy is next sectored into analytically meaningful categories, and an estimate made of the opportunity cost of the marginal tax dollars whose incidence is traced to the several sectors. The study produces an estimate of the opportunity cost of federal expenditures of between 5 and 6 per cent, given the characteristics of the tax models, when the social marginal productivity of resources is equalized in the public and private sectors.

With this estimate of the opportunity cost of federal funds, the social cost of alternative plans is compared with the corresponding social products, treating the difference between the federal and partnership proposals

as project increments. On the heels of these developments, Steiner<sup>18</sup> developed an investment decision model designed to evaluate potential partnership developments on the assumption that a budget constraint does obtain in the public sector. Steiner assumes that the public budget is given and fixed; a similar assumption is made with respect to the capital ration for the private sector. A corrolary of these assumptions is that a particular public investment in the water field must come at the expense of alternative opportunities in the public sector, and that where a public investment preëmpts a supra-marginal private investment opportunity, private investment funds thus displaced find alternative employment in marginal investment opportunities in the private sector. On the assumption that the constraint applies to capital rather than to total outlays, the magnitude to be maximized (subject to the capital constraint) consists of the difference between: (1) the present value of the sum of the net benefits from the public development and net returns from the marginal private investment, and (2) the present value of the sum of the net benefits foregone from other expenditures in the public sector and the net returns otherwise available from the private investment opportunity precluded by the public project.

A conceptually attractive feature of the Steiner model is that it provides a means of determining the optimal allocation to the water resources field, given a fixed total public budget; i.e., an objective function is specified such that the maximum conditions yield an equal social marginal product for capital in all sub-sectors of the public sector. Moreover, it takes into account explicitly the yields foregone in the private sector by reason of a public preëmption of a supra-marginal private opportunity under conditions wherein the assumptions governing the capital rations are realistic.

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<sup>&</sup>lt;sup>18</sup> Peter O. Steiner, An Economic Model of Efficient Public Expenditures in Water Resource Development (Harvard University, Water Resources Seminar, processed).

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While it is possible that a set of circumstances could prevail in which the assumptions of the model would be in approximate accord with real. itv. a number of observations seem warranted. In the United States at least, while the initiative for public investment theoretically resides with the executive branch, and planning by the water development agencies must recognize the budget ration fixed by the executive, the considerable initiative taken by the congress in authorizing public works modifies the effectiveness of the executive budgetary curbs. Individual projects may be authorized and funds for their construction appropriated without reference to the totals budgeted by the executive branch for use by the water resource development agencies. Moreover, the possibility of a public preëmption of a private investment opportunity is restricted largely to power projects. A power project contributes to the same region's power supply whether publicly or privately developed. Accordingly, since the investment opportunity is preëmpted, and utilities do not have internally generated funds for alternative reinvestment<sup>19</sup> it appears of greater probability that a public preëmption of an investment opportunity, coupled with the reality of congressional initiative, would be accompanied by a siphoning out of the public sector the investment funds which otherwise would have been devoted to the displaced private investment opportunity. These considerations, lessen the force of the argument in favor of a model which assumes an inflexible division of capital between the public and private sectors.20

This is as far as recent developments on investment criteria have taken us. Whatever the relative merits of alternative formulations of the investment criterion may be, all have contributed to a growing awareness that no single formulation has universal applicability. Instead, it is now recognized that there is need to develop criteria for each of the generic classes of realistic possibilities, to provide a shelf of models from which the professional practitioners in the field can choose the one which is most appropriate to the conditions prevailing.

Benefit Analysis with Particular Reference to International Streams

Progress in the field of evaluating benefits has been perhaps less concentrated than it has on the investment side of planning criteria, Partly

<sup>19</sup> Since electric utilities are regulated monopolies, rates for service are fixed so as to assure a rate of return which precludes financing of plant except by resort to external sources in response to specific investment opportunities.

<sup>&</sup>lt;sup>20</sup> If in fact the constraint is not effective due to the independent action of the Congress, the four sector Steiner model collapses to the simple two sector model employed by Krutilla and Eckstein. The objective function as formulated by Steiner, however, can be modified to reflect intermediate positions between the polar cases represented by the original Steiner and the Krutilla-Eckstein models. This is a conceptual virtue whether or not it has operational possibilities.

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for this reason only the briefest bibliographic reference shall be given to the contributions by such investigaors as Clark, Grant and Kelso;<sup>21</sup> Curran;<sup>22</sup> Eckstein;<sup>23</sup> Krutilla;<sup>24</sup> McKean;<sup>25</sup> Meyer, Peck, Zwick and Stenson;<sup>26</sup> Renshaw;<sup>27</sup> Ulrich;<sup>28</sup> and others. Some of these contributions were done within the context of analyzing water resource development problems; others are in independent fields having implications for benefit evaluation for river basin planning criteria. Remarks shall have to be confined to a critical aspect of benefit evaluation when river basin planning involves the development of an international stream.

Eckstein, so far as I know, was the first to state fully the fundamental significance of specifying the sequence of project additions to a system, for efficient programming of river basin development and project evaluation.29 The direct interdependence among project elements of a river basin program creates investment complementaries. This is particularly true in the case of storage reservoirs and run-of-river hydroelectric installations.30 In the case of an international stream such as the Columbia River, maximizing the value of the benefits from its development may require the construction of storage capacity, the real costs of which may fall predominantly in Canada, whereas the real gains will accrue predominantly at United States power plants downstream. The fact that the real costs and the gains occur in different countries makes it of critical importance to specify accurately the benefits from such storage sites in order to achieve a viable agreement for joint development of the most efficient system. The benefits attributable to a particular storage reservoir, however, depend on the sequence of its addition to the system, since successive equal increments of storage, other things being equal, add diminishing incremental benefits. This follows since the reservoir contents must be spread

<sup>&</sup>lt;sup>21</sup> John M. Clark, Eugene L. Grant, and Maurice W. Kelso, Report of the Panel of Consultants on Secondary or Indirect Benefits of Water Use Projects, to Michael Strauss, Commissioner of Reclamation, June 26, 1952.

<sup>&</sup>lt;sup>2</sup> Charles D. Curran, "Evaluation of Federal Navigation Projects," Task Force Report on Water Resources and Power, Commission on Organization of the Executive Branch of the Government, Volume III, p. 1330.

<sup>&</sup>lt;sup>28</sup> Otto Eckstein, Water Resources Development, especially pp. 146ff, 167ff & 206. <sup>24</sup> John V. Krutilla and Otto Eckstein, Multiple Purpose River Development, Chapter III.

<sup>&</sup>lt;sup>25</sup> Roland N. McKean, Efficiency in Government Through Systems Analysis, Chapters 10 and 11.

<sup>&</sup>lt;sup>26</sup> John R. Meyer, Merton J. Peck, Charles W. Zwick, and W. J. Stenson, *The Economics of Competition in the Transportation Industry*, Cambridge: Harvard University Press, in press.

<sup>\*</sup>Edward F. Renshaw, Toward Responsible Government, an Economic Appraisal of Federal Investment in Water Resources Programs, Chicago: Idyia Press, 1957.

Rudolph Ulrich, "Relative Costs and Benefits of Land Reclamation in the Humid Southeast and the Semi-Arid West," Journal of Farm Economics, Vol. XXV, No. 1.
 Otto Eckstein, Water Resources Development, pp. 32, 126-27, and 256.

<sup>&</sup>lt;sup>30</sup> See Krutilla and Eckstein, Multiple Purpose River Development, pp. 61 ff.

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over successively longer critical period, diminishing thereby the prime

power gain.

Since the order in which storage sites are developed determines the gross benefits attributable to such developments, it may be thought that in order for each nation to maximize the gains it can claim, each should press for having its storage reservoirs first added. This, I believe, can be demonstrated to be incorrect.

To illustrate, let us take an extreme example. Country A and Country B each have two storage sites contending for priority as "next added." Assume they are identical in every respect (capacity and elevation, with identical developed heads downstream) except for cost. That is, gross benefits, G, are identical if one site is substituted for any other in a specified sequence of development:

$$G_{A1} = G_{A2} = G_{B1} = G_{B2}$$

but, of course, any one added later in the sequence has an incremental value less than preceding storage elements in the sequence:

$$G_1 > G_2 > G_3 > G_4$$

The cost of the storage, on the other hand, is assumed to differ for each site in the following manner:

$$C_{{\scriptscriptstyle A}{\scriptscriptstyle 1}} < C_{{\scriptscriptstyle B}{\scriptscriptstyle 1}} < C_{{\scriptscriptstyle A}{\scriptscriptstyle 2}} < C_{{\scriptscriptstyle B}{\scriptscriptstyle 2}}$$

Assuming further that:

$$G_{\scriptscriptstyle 1} \geqslant C_{\scriptscriptstyle B2} > G_{\scriptscriptstyle 2} \geqslant C_{\scriptscriptstyle A2} > G_{\scriptscriptstyle 3} \geqslant C_{\scriptscriptstyle B1} > G_{\scriptscriptstyle 4} \geqslant C_{\scriptscriptstyle A1}$$

What might be some principles of ordering priorities?

Let us consider one approach which assumes that the representatives of the two nations, motivated by a spirit of amity are reluctant to take advantage of their opposite numbers. They agree to alternate, first one nation's site is given priority, and then the others. Moreover, this is done with the understanding that the maximum number of sites be developed subject only to the constraint that the added gains from each compensate for its costs. Straws are drawn and the first choice falls to B which choose B2, followed by A's choice of A2, followed successively by the selection of B1 and A1. The agreement is satisfied in this manner, i.e., it produces the maximum development consistent with the constraint that the added cost of each project (in that sequence) is covered by project gains.

This is not unlike, in principle, what results when planning personnel, unable to predict the sequence of development in a political environment, visualize the maximum development which can be justified on the assumption that all project elements are brought into being simultaneously, and benefits are allocated in some proportion to the costs.

Another approach, however, seems preferable to me. This would involve an application of the economic principle; i.e., add successive increments in ascending order of their costs. In this manner the most economical storage site, (A<sub>1</sub>) would be first added with a benefit of G<sub>1</sub> indelibly associated with it, followed by development of site B<sub>1</sub> with an added gain of G<sub>2</sub> attributable to it. However, since the gains from the next added storage are less than the cost associated with its development, and similarly for the fourth site, these would be omitted from the efficient program.

What criteria are implicit in the two approaches? In the first approach the criterion is maximum development. That is, it maximizes the development which can be "justified" by the fact that total benefits exceed total cost. An alternative equivalent expression of this criterion is maximization of the development agencies' expenditures with respect to the river basin. But it may result in no appreciable net gain. The surplus of gains over costs associated with the construction of the two most efficient sites can be dissipated to cover the excess of costs over gains in undertaking the next two sites. Application of this criterion can result in a destruction of as much wealth in one form as it creates in another.

The alternative approach has its basis in a welfare criterion; i.e., resources are so allocated that no redirection from one application (planned commitment) to another could produce greater returns in the alternative employments. This condition is met if sites 1 and 2 are undertaken, but not if development is extended to include sites 3 and 4. This criterion, if systematically applied, will maximize the contribution which development of the river can make to the incomes of the two nations combined.

Does it follow equally that if all the sites justified by the welfare criterion occur in only one of the two countries that it remains to the advantage of the other to encourage a sequence of development based on the welfare criterion? In the final analysis this depends on the agreement reached between the two nations with respect to sharing of net gains.

The decision model which employs the welfare criterion is consistent with maximizing the joint welfare function specified for the two countries combined. The maximum net gain from exploiting the resources of the river basin can be achieved in this manner, thereby providing the largest net benefit for mutual sharing. But realistically considered, the guiding principle for representatives of the two nations must be welfare maximization for their respective nationals. If, for example, the most economical sites are in the headwater nation, and that nation requires all of the net gains which accrue in the downstream nation as a condition for developing the storage, then it is to the latter's advantage to

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develop its own storage providing the alternative sites within its borders will provide some net gain. Such sub-optimization achieves gains for the downstream nation at the expense of the potential benefits available from joint optimization, yet would justify such action from a nationalistic viewpoint if it otherwise would not share in the net benefits. This suggests a realistic basis for a viable agreement with respect to compensation to induce development in one nation having external economies for the neighboring country.

It can be assumed that neither country will acquiesce in a share of the net gains from cooperative development which is smaller than it can realize by pursuing an independent course of action. Welfare economics can guide the selection of criteria for planning river basin development on the assumption that each nation pursues an independent course. A welfare function specified for each nation separately (and independent of the external diseconomies its maximization may inflict on the neighboring country), 31 can provide the investment criteria for application within this sub-optimization context. By reason of the external economies-diseconomies problem inherent in a system of physically interdependent works, the sum of the net gains from individual sub-optimization will be less than the net gain from maximizing the joint welfare function. If each nation accepts as its minimum share of the net gains from joint development an amount equivalent to the maximum it can achieve from pursuing its most attractive independent alternative, the area for negotiation with respect to residual net benefits is clearly defined, and an environment is created in which the most efficient system of development from both parties' points of views can be undertaken.

The analysis can be extended equally to a case where the headwater nation has the opportunity of integrating its reach of the commonly shared river basin with an independent domestic river system, as for example, the upper Columbia and the Fraser systems in British Columbia. One cannot say a priori that maximizing the net gains from joint development of the Columbia River will contribute more to the income of the two economies combined, than would the maximization of the net gains from integrating a portion of the common river system with another independent river system. If the full head of the Fraser can be developed economically<sup>32</sup> and would be justified independently of the Columbia diversion, it is conceivable that the net gains from such a development combined with those from sub-optimizing on the lower reach of the

<sup>&</sup>lt;sup>at</sup> Subject of course to the restraints imposed by international treaties, conventions or the international law governing cases for which both nations accept jurisdiction of the International Court.

<sup>&</sup>lt;sup>32</sup> This assumes that the problem involving the spawning grounds for anadromous fish can be satisfactorily resolved.

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Columbia, subject to the diversion, could exceed the sum of the net gains from optimizing with respect to each basin separately. For example, the diversion costs could be offset in greater or lesser degree by transmission economies stemming from the generation of power nearer the load centers in British Columbia.

The time distribution of costs and gains will be a critical factor in evaluating the alternatives under these circumstances. The head is already developed along the United States reach of the Columbia, whereas the development of the Fraser is a matter for the future, pending resolution of some stubborn problems. Assuming that these problems will be solved, but only in the future, the superiority of the diversion plan as judged by the sum of the *undiscounted* annual net benefits, would have to be the greater the more distant in time that the diversion would become feasible. That is, the value of the future stream of net benefits attributable to the diversion, discounted to the point in time at which the diversion would become feasible, would have to exceed the sum of (1) the present value represented by the Canadian share of the net benefits realizable from immediately developing a cooperative plan, and (2) its reinvestment yields during the interval before the diversion became feasible.

If this represents a realistic possiblity, the only remaining prospect for cooperative development of the Columbia would be for the two nations to proceed recognizing that diversion would be a possibility at some future date. The date would have to fall sufficiently in the future so that the present value of the United States' share of net benefits during the interval would exceed the present value of the net gains from developing the United States' most attractive independent alternatives. Whether or not the gains from cooperative development during the interval would compensate for the alternative yields foregone, along with the risk of future preclusion of presently feasible United States' sites, is a question which cannot be answered in the absence of intensive analysis.

The most careful analysis of such questions is required in order that each nation can rest satisfied that it enters into an agreement with the most accurate relevant information. Moreover, such an analysis would enable the nationals of each country to enjoy the returns from a development firmly based on economic welfare criteria rather than a development resulting from tactics to achieve cooperation at the expense of the welfare contribution available from developing the river rationally. As an end product, I can conceive of obtaining data for a pay-off matrix, based on the several physical alternatives incorporating the time element explicitly into each alternative, combined with the net gains imputable to each alternative under different assumptions as to the investment criteria appropriate to the different means by which the physical plans could be under-

taken financially. This would provide decision makers with the information which would (1) assist the planning of the most efficient system, and (2) permit inferring the minimum share which each nation requires out of the

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joint development to induce its participation.

Beyond this, welfare economics can provide no guidance. The residual net gains from cooperative development (above the minimum each nation requires to place it on the margin of indifference) represents the classical distribution problems for which formal welfare economics can offer no assistance. Here perhaps the theories of bargaining and negotiation, or possibly the theory of games<sup>33</sup> may provide useful tools for predicting the final outcomes (though not of evaluating their equity). But the problem of distributing the residual net gains is not essentially a part of the planning and evaluation of river basin projects consistent with welfare maximization. It is necessary only to program a system which will maximize the net benefits for mutual sharing. How the residual gains are to be shared between the two nations is not a problem which technicians are qualified to decide; rather it falls within the province of the politically responsible decision makers.

The two most significant recent developments for river basin planning and evaluation with implications for development of international streams have been stressed here. Attention was first focussed on recent developments in the area of expenditure criteria, which suggest a variety of criteria appropriate to maximizing an objective function subject to different side conditions. Since international streams fall within two or more political jurisdictions, the likelihood of different criteria being appropriate for the separate reaches of the basin, even under cooperative development, should not be overlooked. Moreover, in view of the imperfections in the capital market which may in fact be more significant in connection with financing a program of interdependent investments in two or more political jurisdictions, the empirical content as well as the form of criterion may differ for parties to the development of international streams. These considerations may be significant for planning of an efficient system for cooperative undertaking as well as suggest alternative means of financing development so as to minimize the social cost of a given development.

The second major point concerned the sequence in which projects are introduced into a system of complementary works: its significance for the problem of determining the most efficient system and evaluating benefits of specific project elements. The planning of river basin development for

<sup>&</sup>lt;sup>33</sup> Game theory will not provide a clear-cut solution to the general problem, i.e. the admixture of community and conflicts of interest. The community of interest element leads to joint maximization with departures resulting in a nonconsistent sum game. Conceivably by ingenious formulations of some elements of the problem the division of the constant sum residual net benefit may be amenable to game theory treatment.

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streams under divided jurisdiction is greatly complicated by the problem of reaching agreement as to the division of net gains. Application of welfare criteria to the programming of development, and the analysis of alternatives available within each political jurisdiction, was suggested as a means of narrowing the area of disagreement and moving the problem of sharing gains outside the range in which it could compromise the programming of an economically efficient system.

# DISCUSSION: SOME RECENT DEVELOPMENTS IN RIVER BASIN PLANNING FOR EVALUATION

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Krutilla has given us an excellent summary review of some of the recent publications of interest in the field of economic planning and evaluation of water resources projects. These publications have emphasized efficiency criteria appropriate for use in planning where investment funds are limited and where "partnership" projects are involved.

In passing, I want to mention that neither "budgetary constraints" nor "partnership" projects are exactly new. I cannot recall any time when adequate funds were available to construct all the projects that were considered desirable for development. Also, joint private and public development has been a long standing feature of development programs, particularly where land improvement has been involved.

I can see no objection to Krutilla's choice of the years since 1952-53 as identifying a recent period. I would, however, urge reconsideration of his first reason where he states that it marks roughly the end of a period during which the evaluation procedures were those developed in the "Green Book" and "Circular A-47" and the beginning of a period in which greater emphasis was placed on analyses aimed at maximizing returns under conditions with budgetary constraints. While the recent writings by McKean, Eckstein, Steiner and Margolis all emphasized budgetary contraints more than the "Green Book" and "Circular A-47," it should be recognized that both the "Green Book" and "Circular A-47" emphasized procedural recommendations and could not deal with all their theoretical implications. The deliberations and unpublished background material leading to the recommendations gave attention to various types of constraints, including those associated with a limitation of investment and operating funds.

To me, the "Green Book" does not mark the end of a period, but rather the beginning of a period in which there has been a growing recognition

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of the role of economics in the formulation of resource development projects and programs. I recognize that consideration of budgetary constraints may be a theoretically desirable refinement of evaluation techniques but I am of the opinion that practical considerations may limit application of such refinements to modifications of certain evaluation standards, such as adjustment of the discount rates and the "cut-off point" for acceptable project benefit-cost ratios. This would be still far short of a theoretically desirable consideration of the effect of budgetary constraints throughout the process of project formulation.

Krutilla's discussion of recent developments in river basin planning and evaluation could well have been broadened to include more on the solution to problems being encountered in use of the incremental approach in project and program formulation. There has been increasing recognition that proper project formulation is the core of the evaluation problem and that if project formulation is properly carried out the project benefits must necessarily exceed project costs. It is easy to say that total benefits should be compared with total costs, but do total costs in the benefit-cost ratio include associated costs and, if not, what rate of return should they be permitted to earn for the purpose of the economic analysis of a project?

Due to the multiplicity of possible combinations and scales of development as well as the incompleteness of measurement techniques, detailed consideration in project formulation can be usually given to only the more promising possibilities. Practical judgment and experience must often be relied on in selection of those projects and alternatives to receive detailed study. This emphasizes that, while in practice the basic principles of project formulation are accepted, there are numerous unresolved problems in applying the principles. A major problem is in determining the products of a project to which monetary values should be attached. This is relatively easy for power projects but for projects involving flood control and land reclamation the products of the project are not so definite and it is even more difficult to determine the net benefits attributable to the project.

Many persons are of the opinion that there is still so much to be gained from improvement in application of the basic formulation principles that the gains from incorporating the refinements involved for consideration of budgetary constraints will be relatively small. Furthermore, it may be impossible to predict what such constraints will be in the future and project analyses frequently precede development by more than a few years.

In the second part of the paper, Krutilla points out some of the complicating problems of analyses that arise in planning for development of international streams, such as the Columbia River. His suggestions for both basin-wide and regional types of economic analyses are, in my opinion, very appropriate. Such analyses should indicate the nature and t proj-

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extent of developments that will maximize the net social or over-all public gains if appropriate consideration can be given to all project effects. It should be recognized, however, that the problems in planning and development of international river basins are basically the same as those encountered in our larger river basins where a number of states are involved. Treaties between countries and compacts between states have essentially similar effects on river basin planning and development. They both can be modified in the interest of more efficient use of the basins resources, but approval of proposed changes will likely be forthcoming only if it can be shown that modification will be advantageous to each of the jurisdictions concerned.

In the latter part of the paper, Krutilla expresses a view that the distribution of project gains is a field in which welfare economics can provide no guidance. My view is that economists should be very much concerned with how the project gains are distributed and that we should seek to make meaningful studies that will guide the decision makers.

#### SHARING FINANCIAL RESPONSIBILITY OF RIVER BASIN DEVELOPMENT<sup>1</sup>

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MARK M. REGAN
Agricultural Research Service, USDA

SHARING financial responsibility of river-basin developments involves the division of project and program costs among purposes, interests, groups, and individuals. All costs of establishing and maintaining resource programs must be borne by someone. Costs not assigned to specific individuals or groups must be borne by the local, area or national public. Expected to share in these costs are (1) the primary beneficiaries who receive immediate project services; (2) secondary beneficiaries; (3) states or provinces and local agencies or districts; and (4) the national public.

Arrangements for cost-sharing are many and varied. They include the use of charges and assessments to recover all or part of the initial capital outlays and meet annual costs; and various forms of cost-sharing agreements among participants concerning direct responsibility for project segments or providing specified types of resources, materials, services, or other contributions.

The difference in emphasis between evaluation and cost-sharing is sufficient to warrant a reasonably sharp distinction between the two. Whereas evaluation is concerned primarly with benefit-cost relationships in production, cost-sharing centers attention on the distribution or incidence aspects of project effects. Efficiency in producing services is the controlling consideration in evaluation; in cost-sharing, emphasis is on equitable distribution arrangements.

A divergence in viewpoints leads to certain differences in approaches appropriate for each. For evaluation purposes, for example, secondary benefits often represent a transfer effect. To the extent that such benefits can be identified, however, they provide as valid a basis for the distribution of costs as do direct benefits. The ability of a particular group of beneficiaries to bear project costs is independent of whether their benefits represent a net social gain or merely constitute a transfer from another group. The amounts of secondary benefits that merit consideration in cost-sharing and reimbursement may exceed those available for the economic justification of a project from a national or social viewpoint. In evaluation, the cost of uncompensated damages is clearly a project cost, although usually it is not included in the costs that are shared.

<sup>&</sup>lt;sup>1</sup> The opinions expressed are those of the author and do not necessarily represent the views of the Farm Economics Research Division, Agricultural Research Service, or the USDA. The author is indebted to E. W. Webber, N. A. Back, A. R. Johnson and John V. Krutilla for helpful suggestions.

The standards for reimbursement and evaluation may differ also. Reimbursement usually involves contractual obligations that require dollar payments, and possible price fluctuations become more significant than in evaluation, with its greater emphasis on purchasing power or real values. Also, the dollar costs that must be paid by an individual or group may vary from the social cost of utilizing resources. From the viewpoint of individuals or local groups, the cost is the money outlay necessary to acquire resources or services; from the viewpoint of the public, the cost is the productivity of the resources in alternatives that are foregone.

Despite the differences indicated, reimbursement and evaluation considerations cannot be completely separated. Assessment and reimbursement requirements often provide an effective check on the reliability of the evaluation estimates. The willingness of individuals to pay for services is substantial evidence of the existence of benefits. Also, when charges are likely to influence the utilization of project services, their effect on project benefits must be considered. Although these interrelationships must be recognized, it is believed that most aspects of the cost-sharing problem may be treated more systematically if considered as distinct rather than integral parts of the evaluation problem.

Although some attention has been given to cost-sharing as either an aspect of resource policy or an incidental phase of evaluation,<sup>2</sup> a systematic analysis centering on cost-sharing comparable to recent texts on evaluation is yet to be developed.<sup>3</sup> Logically, the broad field of financial responsibility distribution covers all aspects of the incidence of project effects. It includes consideration of project impacts on regions, areas, groups, and individuals; the compensation required to make those adversely affected at least as well off with as without the project; the ways in which cost-sharing requirements may be used to adjust incidence; and the possibilities and limitations of alternative means of controlling incidence. This paper attempts to deal with only a part of the broader field indicated. Attention centers primarily on the approaches, guides, and problems involved in the division of project costs among interests and participants.

The economic, institutional, and policy considerations that have a

<sup>2</sup> Typical are Missouri Basin Survey Commission, "Missouri Land and Water," 1953; The President's Water Resources Policy Commission, "A Water Policy for the American People," Volume I, 1950; and The Presidential Advisory Committee on Water Resources Policy, "Water Resources Policy," 1955.

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<sup>&</sup>lt;sup>3</sup> Three major texts on evaluation have been released this year: John V. Krutilla and Otto Eckstein, Multiple Purpose River Basin Development, Baltimore: Johns Hopkins University Press, 1958; Otto Eckstein, Economics of Water Resource Development, The Economics of Project Evaluation, Cambridge: Harvard University Press, 1958; and Ronald N. McKean, Efficiency in Government Through System Anlysis, With Emphasis on Water Resource Development, New York: John Wiley and Sons, 1958.

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bearing on cost-sharing are so numerous and so intertwined that neither a single nor a simple formula would appear to be approprite for all situations. The chief types of considerations that warrant attention in devising arrangements for sharing financial responsibility are: (1) The objectives to be served; and (2) the merits and limitations of alternative basic approaches for apportioning charges or assessments. Attention must also be given to the adjustments and modifications necessitated by problems of practical application and acceptability

#### Purposes and Objectives

What purposes and objectives should cost-sharing requirements be designed to serve? Their general purpose, of course, is to distribute costs in such a way as to best serve the public interest. To accomplish this, cost-sharing requirements should be regarded as a positive means of maximizing the net social benefits from the use and distribution of project resources and services. The requirements have two main purposes or objectives: (1) contributing to the efficient use of resources; and (2) promoting incidence and distribution policies. The desired arrangements are those under which conflicts between these two objectives are minimized.

The contribution toward efficiency goals stems from the effect that assessments and charges have on the use of project services. The absence of any charges might well induce a waste of services by beneficiaries, increase the pressure for unjustified projects by local interests, and provide insufficient incentives for participation. Excessive charges could result in underutilization of project services and failure to realize project potentials.

Promoting the attainment of other objectives of public policy also merits consideration in establishing cost-sharing requirements. These objectives include stimulating area and regional economic development, encouraging owner-operation of family-sized farms, minimizing windfall gains, maintaining adequate levels of living, promoting increased economic stability through the reduction of risk, and providing flexibility in repayment arrangements.

Little question arises concerning the desirablity of taking account of these objectives in cost-sharing requirements. The chief issues relate to the impact of such provisions on efficient resource use and the effectiveness of alternative means for their accomplishment. Optimum development and use may be obtained under a range of charges and assessments, and other means are available for controlling the distribution and use of

<sup>&</sup>lt;sup>4</sup> Whether the charges are fixed or variable has a direct bearing on use. For a discussion of various aspects of this problem see Michael F. Brewer, "Water Pricing by Small Groups," *California Agriculture*, April 1958; and S. V. Ciriacy-Wantrup, "Cost Allocation in Relation to Western Water Policies," *Journal of Farm Economics*, Feb. 1954.

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project services. Frequently, both distribution and efficiency goals can be served if a reasonably close association is maintained between the incidence of benefits and costs. Benefit recipients are usually in a position to bear charges; while charges geared either to costs or to the value of services are likely to promote efficient use.

Desired distribution patterns for such attributes as land use and ownership might also be obtained by direct regulations. The 160-acre limitation and associated antispeculation provisions under United States reclamation law illustrate types of such regulations. Only farms of the permitted size are eligible for participation; all others are excluded. Differential charges could accomplish many of the desired distribution effects and perhaps be less likely to conflict with efficiency objectives. To the extent that differential charges absorbed windfall gains, they would reduce the need for antispeculation restrictions. Thus, family-sized farms might receive preference in the form of lower assessments and deferred repayment periods that would not be available to larger units. Or higher or graduated charges or assessments might be placed on acreages above a given size.

The need for considering the ultimate rather than the immediate aspects of incidence is often overlooked. If a wide distribution of benefits is emphasized, provision needs to be made for benefits reaching direct users of project services throughout the life of the project. When services are provided at less than their value, the advantage may be largely absorbed before reaching the intended beneficiaries. For example, if flood control or irrigation is provided for a charge substantially less than its value, present landowners would be in position to appropriate the capitalized value of the net benefit in case of sale. Succeeding owners would bear land costs approximating the value of the benefits and would receive no net advantage from the project. Any part of the value not absorbed as a project charge would go to a previous owner. In case benefits are subject to appropriation, either project charges should be sufficient to limit windfall gains or provision should be made to return the gains to the public. Otherwise the possibility of accomplishing long-term redistribution objectives through low project charges would be limited.

## Bases for the Division of Financial Responsibility

Bases for apportioning financial responsibility may be grouped into two main categories: (1) charges and assessments based on project costs; and (2) charges and assessments based on the value of project services. Each category has several variants and cost-sharing requirements could incorporate various combinations of the two.

# Cost Basis for Charges and Assessments

Under the cost approach, the sharing of financial responsibility among interests is geared to and limited by project costs. The main variants con-

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sist of (1) sharing costs in proportion to benefits; and (2) assigning the full cost of specified purposes to particular users or classes of beneficiaries.

The costs to be shared consist of those for initial installations and the recurring costs for operation, maintenance, and replacement. All such costs may be expressed in either present value or annual terms. In annual terms, initial investment costs take the form of amortization allowances needed to retire the investment with interest over the life of the project,

For single-purpose projects, the necessary cost base is directly available and the total costs are distributed among the participating interests. In the case of multiple-purpose projects, an appropriate share of any joint or common costs must be added to the separable cost of each purpose. Thus, an initial step in the division of financial responsibility based on costs is the allocation of any joint costs among purposes.

Cost Allocation:—Many different cost allocation procedures have been proposed and several are used in prevailing practice.<sup>5</sup> Their purpose is to provide a rational basis for apportioning costs of jointly used facilities among the purposes served. The range in results obtained from different methods is often wide, and the implications for cost-sharing are substantial.

An appropriate cost-allocation method should allow each purpose to share proportionately in the advantages that result from the use of common facilities. The allocation should be consistent with proper economic formulation in that the total costs allocated to any purpose should be at least sufficient to cover the separable costs of its inclusion, but not in excess of the lesser of the benefits or alternative costs. The procedure is not an integral part of project formulation and hence should not preclude any purpose that produces benefits sufficient to cover its separable costs.

A method that meets the principal tests for an acceptable procedure is the Separable Costs-Remaining Benefits Method proposed by the Subcommittee on Benefits and Costs of the Federal Interagency River Basin Committee.<sup>6</sup> Under the method they recommend, each purpose is first charged with its separable costs. This cost is the difference in the total project cost resulting from the inclusion or deletion of any purpose. The difference between the sum of the separable purpose costs and the total project cost constitutes the common costs chargeable to all purposes served. This residual is distributed among purposes in accordance with the excess of its benefits over its separable costs. Alternative costs take the place of benefits when they are less.

The method has gained rather widespread acceptance in the United

<sup>&</sup>lt;sup>5</sup> For a comprehensive discussion of various cost allocation methods, see J. S. Ransmeier, *The Tennessee Valley Authority*, Nashville: Vanderbilt University Press, 1942.

Proposed Practices for Economic Analysis of River Basin Projects, May 1950.

States, both in agency practices and in recommendations made by various commissions and study groups. The chief modifications in application arise from the absence of adequate data on separable costs. This often necessitates the substitution of specific for separable costs in the formula.

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Despite its general acceptance, certain unresolved questions arise in the application of the method to cost-sharing. One issue centers around the stage in the cost-distribution process at which account should be taken of secondary benefits. If cost allocation is regarded as a method of imputing responsibility for project costs among purposes from a public viewpoint, then it would appear to be appropriate to disregard transfer-type secondary benefits in the initial allocation. Any secondary benefits above those considered net project benefits would be needed to balance secondary benefits foregone from alternatives. Hence they would not be available to justify an increase in project costs assigned a particular purpose. Each purpose would share in joint costs in accordance with its contribution toward the net social benefits of the project.

Under this reasoning, the more appropriate stage for taking account of local secondary benefits would be in the division of allocated purpose costs among the benefited interests. Emphasis at this stage centers more on questions of individual and group incidence, with no need for distinguishing between transfer and net-project types of benefits. Only net-purpose benefits would be used in the allocation among purposes, with account taken of local and area viewpoints in the distribution of allocated purpose costs among groups and interests.

Another group of issues on cost allocation procedures relate to the treatment of alternatives. These include questions as to whether alternatives should be used as a limit on the allocation or as a measure of benefits; whether the alternative should be based on public or private cost standards; and the extent to which a multiple-purpose site may be used in computing the cost of a series of single-purpose alternatives.

Under the standard Separable Costs-Remaining Benefits method of allocation, alternatives, in effect, are treated as a measure of benefits. However, no essential characteristic of the basic method would be lost if alternatives were used as a limitation on the allocations. The primary distribution of joint costs could be based on benefits, with allocations permitted to approach alternative costs. Although this modification would increase the allocation to purposes with low-cost alternatives in relation to benefits, the net allocation might well be more in accord with their capacity to carry costs.

When both public and private standards are involved in evaluation, the question of which is appropriate for determining alternative costs in cost allocation becomes pertinent. As only alternatives that are real in terms of those likely to develop in the absence of the project are signifi-

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cant, the use of costs applicable to such expected alternatives would appear to be appropriate. With benefits based on the costs of the most likely alternative source, the alternative cost and benefit base for the allocation of project costs to such purposes as power would often be the same.

Under prevailing practice in the United States, a multiple-purpose site is frequently used as a basis for computing the alternative single-purpose cost of each of several alternatives. As alternatives should represent a source of comparable service expected to develop in the absence of the project, they must be independent of the particular project under consideration. Assuming that a multiple-purpose project provides optimum use of a given site, such a site would no longer be available for developing alternatives that could be realized for the various separate purposes. Project development would preclude any other uses of the site, and it would be inaccessible for any single-purpose development.

Allocation of costs among purposes is only the first step in the process. More controversial issues arise in the distirbution of the purpose allocations among and between the interests and groups that benefit.

Costs Shared in Proportion to Benefits:—This approach involves the distribution of project costs in accordance with benefits. The costs assigned to any interest or group would depend on the relative amount

of the project benefits they received.

Although the method has considerable appeal as a reasonable and equitable approach, in application it has certain rather serious limitations. Both measurement and conceptual problems arise in attempting to appraise and compare benefits that accrue to interests with differing viewpoints. The main difficulty comes from attempts to classify and measure benefits that accrue to local compared with national interests.

For classification purposes, general public benefits could be defined to cover contributions to such activities as defense, maintenance of high employment levels, conservation of resources, and attainment of other objectives considered to be national responsibilities. In addition, benefits that were widely dispersed among individuals and areas might also be considered as general public benefits. Many of the benefits indicated would be difficult to measure in quantitative terms and their consideration in cost-sharing would often need to be largely qualitative.

Conceptual problems also arise in dealing with effects that are benefits from a local or area viewpoint, but not necessarily from a national viewpoint. Most secondary benefits fall in this category. Logically, national benefits should be net of transfers, while local benefits are any that are

expected to accrue in the zone of project influence.

Thus, the difficulties of measuring public benefits in terms comparable to those of local participants often limits the extent to which a rigid proportional benefits base could be used in apportioning costs between

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rigid tween the two interests. The further distribution of costs assigned to local interests in accordance with benefits would involve fewer complications, as the benefits of those participating could be measured from a similar viewpoint and in reasonably comparable terms. The primary contribution of the approach lies in the distribution of costs among local and area beneficiaries after the initial assignment to local interests had been made. The approach would also be applicable to the division of responsibility between two countries, if the viewpoints involved were reasonably comparable.

Assignment to Users of All Costs of Specified Purposes:—Under prevailing practice in the United States, the full costs of such vendible services as power and municipal water are assigned to users. Irrigation represents a modification in which costs assigned to users are partially reimbursable. In the case of power and municipal water, the costs assigned for repayment through charges or assessments usually include interest and an allocated share of the joint costs. Interest is excluded from the required irrigation repayments and various parts of the initial allocation to irrigation are often reassigned to power or other reimbursable purposes for repayment. In order to establish costs, an allocation of joint costs to the various purposes is required, but for fully reimbursable purposes, the need for a further division between national and local interests is avoided.

Requirements for the full reimbursement of costs assigned to designated purposes has led to the use of cost allocation methods designed to minimize the cost-sharing requirements of the financially weaker purposes. These include assignment of costs approximating benefits to nonreimbursable purposes and the deferral and reassignment of irrigation costs to power and municipal water. The interest-free status of irrigation costs permits their accounting repayment from power revenues that accrue after the payout period for power. The St. Lawrence Seaway provides another example of an extreme shift in allocations. All the joint costs of navigation and power have been assigned to power.

Although full reimbursement is a typical requirement for vendible-type services, the procedures often used in establishing costs have been neither rigorous nor realistic. The approach appears to be too inflexible to serve as a general basis for cost-sharing, as all costs of each of the purposes provided would need to be assigned to identifiable groups of beneficiaries.

Among the difficulties is that of developing an entirely satisfactory basis for deciding which purposes should be fully reimbursable and which should not. Full reimbursement requirements are likely to be most effective in the case of vendible services for which a direct charge can readily be made. Logically, cost-sharing policy should be determined by the

<sup>&</sup>lt;sup>†</sup> Martin Glaeser, "The St. Lawrence Seaway and Power Project," *Land Economics*, November, 1954.

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nature and extent of the public interest involved, rather than solely by the ease of collection. Also, partial reimbursement would appear to be feasible for some purposes that would escape assessment under a policy of either collecting all costs or none.

Despite the limitations indicated, the approach has a place in cost sharing policy. The approach provides a basis for sharing the costs of purposes and activities undertaken wholly for local or area interests and minimum assignments for types of services that enter into direct competition with private alternatives.

## Charges and Assessments Based on Value of Services

If charges and assessments were geared to the value of the benefits, their determination could be largely independnt of project and purpose costs. The division of financial responsibility for project costs would then consist of assignment of charges to identifiable beneficiaries up to the value of their benefits. If returns did not equal or exceed costs, the residual would be borne by the general public. The magnitude of the benefits accruing to specially benefitted groups would be the significant consideration, rather than the relative amounts received by various interests.

If incentives are to be provided for individual and local group participation, the charges and assessments would need to be less than the full value of the benefits received. The charges would also need to be consistent with cost of available alternatives, and further adjustments could be made to bring charges into line with the ability of beneficaries to pay.

The main obstacles to acceptance of the approach as the primary basis for the division of financial responsibility include objections to a departure from the cost basis for determining charges, the latitude permitted for judgment or discretion in fixing the level of charges, and difficulties in establishing the justification for having the residual costs borne by the public 8

The main advantages would include avoidance of controversial problems of cost allocation and difficulties in making precise estimates of national public benefits of the type needed for comparison with benefits accruing to local and area groups. The approach would provide sufficient flexibility to permit charges to be used to stimulate optimum development and use and necessary adjustments could be made for particualr purposes and conditions. The approach would obviate the practice of reassigning repayment obligations and the net costs borne by the public could be clearly identified. It would also provide a means of basing charges on the real or purchasing power value of benefits, and thus allow recovery of real rather than financial costs.

<sup>&</sup>lt;sup>8</sup> Wantrup suggests construction of a demand and supply function that might be independent of project costs as basis for establishing charges. Op. ctt., p. 120.

With assessments for each proposal geared to the ability of identifiable beneficiaries to bear charges, the actual collections realized would probably increase.

#### Components in a Combined Approach

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Various combinations of the approaches indicated are possible. Charges for some purposes could rest primarly on the value of service, with charges for others based on costs. Although prevailing practice in the United States emphasizes costs as a basis for charges for vendible services, values are frequently the real base. The weight placed on values is sometimes obscured by a confusing and often unnecessary cost-determining process. The allocation procedure is such that assigned costs are actually often determined by benefits.

When payments by identifiable beneficiaries are expected to equal or exceed purpose costs, either the cost-of-service or the value-of-service approach would afford an appropriate base for the assignment of financial responsibility. The charges under either could be sufficient to insure reasonably efficient use of project services. Preference for the value-of-service base would depend on the weight given the desirability of recapturing any windfall gains that might accrue from charges that were lower than the value of services. But objections to government profits accruing from resource developments would be avoided by a cost basis for charges. The types of purposes to which either would be applicable would include power, municipal water, and perhaps navigation and other types of vendible services.

When the payments by identifiable beneficiaries are expected to be short of purpose costs, the value-of-service base would appear to be effective for recovering any charges that could reasonably be paid. This is likely to be the case for such purposes as irrigation, drainage, flood control, watershed programs, and recreation. Either direct charges for services or assessments on primary or secondary beneficiaries could be based on values. For some purposes, payments might come partly from service charges and partly from assessments.

The sharing of costs in proportion to benefits would provide a basis for sharing responsibility between countries and could be used in the distribution of assigned costs among individuals and groups. Neither it nor the assignment of full specified-purpose costs would appear to be appropriate as the primary base for a comprehensive national river-basin program.

The feasibility of making reasonably reliable assessments and difficulties of collecting them become a primary concern in considering the practical application of cost-sharing requirements. Groups of expected beneficiaries need to be clearly identifiable; an acceptable basis for determining charges should be established, and a mechanism needs to be provided for the assessment and collection of charges or assessments.

The assessment of direct and indirect beneficaries of many major purposes would probably require the establishment of conservancy or other special-purpose districts having taxing authority. Agreements might also be worked out for assigning a share of the financial responsibility to States and existing local governmental organizations. To the extent consistent with program objectives and purposes, the participation of such groups and interests in planning and formulation should be geared to the financial responsibility they are willing to assume.

#### Cost-Sharing in International Rivers

The considerations that affect the division of financial responsibility for national rivers would appear to be generally applicable to international rivers. Although more complications might be expected to arise, the main differences between national and international river problems are largely of degree rather than of kind.

In national rivers, the objective of cost-sharing is that of adjusting for the disassociation of benefits and costs between individuals, groups, areas, and the nation. In international rivers, it becomes that of devising additional arrangements to compensate for disassociations that occur between

the participating countries.

When greater net benefits would result, it would appear possible to establish cost-sharing arrangements for joint development whereby each participating country would share equitably in its advantages. As a minimum, the net benefits accruing to each country under joint development should at least equal those obtainable under available independent alternative programs. Any gains over such a minimum could be distributed in a way that would allow each country to realize a comparable advantage.

Adequate consideration of each country's independent alternatives would appear to be a major requirement for establishing an equitable and acceptable basis for sharing financial responsibility. A more comprehensive treatment of project costs would be required than is commonly applied in the analysis of national rivers, where no direct allowance is made for site and water resource values. In effect, the net benefits over project costs become attributable to such resources as residual claimants. Allowance for the value of such resources supplied by countries would appear to be a proper component of the total costs of a joint project and creditable as a real cost contributed by participants. Under the assumption that the benefits accuring to each should at least be sufficient to cover the costs incurred, the inclusion of alternative opportunity costs would insure each country of being at least as well off under a joint as under independent development.

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The value of the site and water resources contributions may be measured by their expected productivity in available independent alternatives that are precluded or foregone as a result of the joint project. More precisely, it would be the value of the net benefits expected to accrue within the country from the most advantageous independent alternative likely to be developed in the absence of the joint project. The foregone benefits would be net of required development costs and their value adjusted for time and certainty of occurrence on the basis of standards comparable to those used for the joint project.

The alternatives used must be real in the sense that they are likely to be realized in the absence of the joint project. Also, they should be consistent with the existing state of river-basin development, any governing treaties, and acceptable principles of international law. The restraints imposed by the adoption of such principles of international law as those recommended by the International Law Association at its meeting at Dubrovink, Yugoslavia, in August 1956 would restrict alternatives to those that did not change the existing regime of a river to the detriment of other countries.

The costs of a joint development project would thus include two components: (1) the outlays necessary for establishing and operating the project; and (2) the opportunity costs reflected in the net benefits foregone from available independent alternatives.

The project benefits would need to be sufficient to cover both components of costs, with any excess indicative of the mutual advantage of joint development. The methods appropriate for computing the benefits of national rivers would appear to be generally applicable to international rivers. Some problems of differences in standards might arise, but perhaps much of this could be resolved by applying the standards considered appropriate for the optimum available uses of project services. To the extent that project services were mobile, they would be appraised in terms of their highest available market value.

The primary basis for determining the benefits from the development of a particular site might well be its expected contribution to the planned eventual development program or system. This would involve an estimate of the incremental benefits to the system expected to result from the addition of a particular project. Benefits resulting from any of several segments of a planned program would be common to the system and hence not creditable to a specific segment merely because of its priority in scheduled development.<sup>10</sup>

The division of financial responsibility could take any of several forms. The costs of joint development could be shared in accordance with the

<sup>&</sup>lt;sup>9</sup>Report by a Panel of Experts, "Integrated River Basin Development," United Nations, Department of Economic and Social Affairs, New York, 1958.

<sup>&</sup>lt;sup>10</sup> A prior project under the planned development program could be credited with any increase in system benefits accruing before similar benefits were provided by other planned additions to the system.

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incidence of benefits; benefits could be distributed to correspond to costs incurred by participating countries; various compensatory arrangements might be worked out to achieve a balanced distribution of benefits and costs; or primary responsibility for particular segments could be assigned.

The pattern of assignments, adjustments, and compensation payments could be designed to provide each participating country with the same rate of return on investment or the same ratio of benefits to costs as for the project as a whole. The amount of the costs or the responsibility for segments to be assumed by each country would be subject to negotiation within such a framework.

#### DISCUSSION: SHARING FINANCIAL RESPONSIBILITY OF RIVER BASIN DEVELOPMENT

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Regan has given suggestions that show a familiarity and maturity of judgment about arranging for reimbursement of water resource investments. What follows in part underlines some of his ideas and attempts to build on them. I wish to point toward reimbursement procedures implied if one is less accepting than is Regan of the existing framework for cost-sharing.

Just as it is traditionally said that sunk costs are sunk, so joint costs are joint. This implies abandoning attempts to associate joint costs with particular project outputs. Given that one had to have a cost allocation formula, the Separable Cost-Remaining Benefits method—that figures in much of Regan's paper—has many merits. It provides a logical way of trying to share joint costs in proportion to net project benefits received by users. It seems to be motivated by something like a benefit theory of taxation. Even in the field of taxation, however, one does not expect a benefit theory to provide a sole norm.

Suppose one abandons this approach and instead aims at reimbursement procedures that (1) promote economically efficient project operation and (2) minimize windfalls of users of project outputs. The remarks ensuing try first to show that these two objectives are not likely to interfere with each other. Then it will be pointed out that they, however, provide an incomplete guide to cost sharing. Finally, the view will be expressed that in completing a guide to cost sharing an eye needs to be kept on the second-best context relevant to water resource investments.

In Figure 1—TS can represent the demand for either power or irrigation water, with price measured on the y-axis and quantity on the x-axis. The area OURQ is the amount paid by users of the output. Under most exist-

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ing arrangements the amount of output to users OQ is administratively fixed. OURQ may be collected simply as a flat charge as is often the case for irrigation, or as with power a price RQ may be charged with output rationed at that price.<sup>1</sup>

A usual efficiency suggestion is to charge a price QS and let users have all they want at that price. The idea behind tying payment to the amount of use of outputs and selling them is to try to get them to uses of highest value, equating marginal products in different possible uses. This then determines a reimbursement (OQSV) consistent with efficient operation of the project.<sup>2</sup>

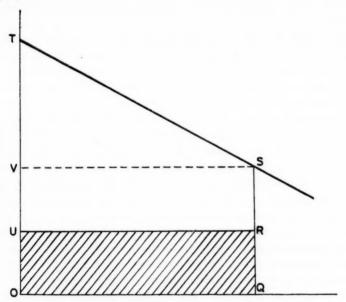


Fig. 1. Sharing financial responsibility of river basin development.

Under present arrangements, there is a windfall at least as great as URSV. This tends to be capitalized into the value of fixed factors with which project output use is connected. If URSV is the entire windfall it is eliminated by the pricing suggestion, and the efficiency and no-windfall objectives are seen to coincide.

Especially for irrigated land, the windfall might be greater than URSV. Even with the pricing suggestion, the value of the land in irrigation may be greater than in dryland farming. Efficiency and no-windfall objectives

<sup>&</sup>lt;sup>1</sup>We might distinguish between firm and nonfirm power and take account of other complications that affect the detail, but not the substance, of the argument.

<sup>&</sup>lt;sup>2</sup>In relation to Regan's paper, the argument is that charges and assessments be according to the second major method he discusses, namely, that they be based on value of services. It is being argued that the cost basis for charges and assessments be rejected.

can still be made to coincide through flat assessments, in addition to the pricing, not connected with amount of output a user buys.

Project outputs might even continue to be directly administered, with reliance entirely on flat assessments to minimize windfalls. Even if the administrative procedures are not aimed directly at economic efficiency, the loss in product may be small.<sup>3</sup> Moreover, often, once the project is built, as with flood control benefit, a project output is not subject to decision. Flat assessments are all that become relevant.

All this emphasizes that efficiency and minimization of windfalls can be consistent objectives. We come down to this question—who then gets the profits from a project if there are any, or who pays the losses if there are losses?

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Profits might be positive; profits might also be negative because social and private points of view diverge; or profits might be negative because the project is truly uneconomic. Dut to space limitation, we can discuss only the most important case. Perhaps sadly, it is necessary to choose the last one mentioned.

When a project does not pay for itself, it seems too easy to stress things like regional development implying no conflicts between national and local motivations. Would it not be better to recognize the conflict explicitly? Here are some things that would need to be taken into account. They are local motivations for having water resource development—rise in land values (primarily off the project, not on); increase in local imperfectly competitive profits, in industries serving increased population; increased tax revenues; political motivations for larger population and for tangible demonstration of action in the form of projects, by those in office.

These motivations put us in a second-best realm from the point of view of resource allocation and, probably also, income distribution. A country like Israel may, for diplomatic and strategic reasons, want to settle eitizens close to the edges of its border. Its welfare maximum may logically call for sacrificing some economic product in order to do this. For the United States, the context of water investment probably implies sacrifices of economic product which cannot be justified at the national level except in terms of trying to rationalize pork-barrel-type politics.

Who should pay for such investments? Possibly in some instances secondary beneficiaries. However, the problem seems too complex to go into at all in this discussion.

<sup>&</sup>lt;sup>3</sup> A forthcoming study by V. S. Hastings and George S. Tolley on the North Platte River reveals this. For instance, irrigation delieveries to farmers ignore water losses involved in the deliveries, but re-allocations that would take account of the losses appear to raise total product very little.

#### ORGANIZATION FOR RIVER BASIN DEVELOPMENT: THE COLUMBIA RIVER\*

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THE Columbia River basin is currently one of the most important from a U. S.-Canadian point of view. The main purpose of this paper is to discuss some of the more important considerations which have relevance to the organizational problem, although it is impossible at this stage to be very definite about many of the unresolved issues which are now under active consideration by different levels of government on both sides of our common border. It may be useful, however, to focus attention on the more important elements of the Columbia River question which are relevant to the problem of organization.

#### Some Physical Characteristics

The Columbia River rises in Canada and flows through the states of Washington and Oregon into the Pacific Ocean. Of the total fall of 2650 feet from Columbia Lake to the sea, 1360 feet occur in Canada and 1290 feet in the United States. The combination of head with large flows makes the Columbia River one of the greatest potential hydro-electric power rivers in North America. The Columbia flows, however, are highly variable; at the U. S.-Canada border the ratio of high to low annual flows is about 40 to 1 while the St. Lawrence, without artificial regulation, has a high to low flow ratio of only 2 to 1. Of the Columbia River basin water, as measured at the Dalles, about 55 per cent crosses the international boundary south of Trail. To date there have been no hydro-electric developments on the main stem of the Columbia in Canada. About 11 million horsepower have been or are being developed within the United States. The physical characteristics of the river and the long distances to the power-marketing area make it uneconomic to develop at-site power in the Canadian portion of the Columbia except in conjunction with storage facilities designed to serve downstream plants.

The Kootenay River, an important tributary of the Columbia, is located in southeastern British Columbia, northwestern Montana and northern Idaho. Three-fourths of its drainage area of 19,300 square miles and two-

thirds of its length of 464 miles are in British Columbia.

The only hydroelectric developments on the main stem of the Kootenay

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<sup>&</sup>lt;sup>e</sup> The author appreciates the comments received from members of the Water Resources Branch of the Department of Northern Affairs and National Resources, from several Canadian and United State officials during a tour of the Columbia River sponsored by the International Joint Commission in July 1958, and from Frederick J. Thorpe, W. Harold Black and Roy A. Faibish.

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River at the present time utilize the 360 feet drop in the 25-mile reach of the river from Nelson, British Columbia, to its confluence with the Columbia River. Power is developed at six plants on this 25-mile reach of the river. The total installed capacity of the six plants is approximately 400,000 horsepower.

Possibilities exist for diverting a part of the headwaters of the Kootenay into the Columbia River. This would provide a measure of flood protection in the lower Kootenay and would result in benefits to the existing and potential power plants on the main stem of the Columbia River in both Canada and the United States. These benefits would be partially offset by the losses to potential and existing installations on the Kootenay River in Canada and potential installations in the United States.

# Some Historical Facts of Significance to Future Development The U.S. Situation

Active federal interest in the development of the lower Columbia did not begin until the 1930's when participation of the U.S. government in resource development was seen as one means of stimulating economic activity and providing work for the unemployed. The following brief historical account is based on the book by Charles McKinley entitled "Uncle Sam in the Pacific Northwest."

In 1935 a bill was introduced for the establishment of a Columbia River authority, patterned in a large part upon the TVA, to handle the whole Columbia River development problem including transmission and marketing of the power to be made available at Bonneville dam and a little later at Grand Coulee. Considerable controversy arose over this proposal. Opposition from existing federal agencies and the private vs. public power issue were at the root of this controversy.

The President requested a special study of the future development of the Columbia River basin by his National Resources committee, a central planning agency for the executive branch of the government. This group took a longer range view of the development of the Columbia River valley and predicated their recommendation upon a conception of region-wide interests and benefits. The committee recommended a central grid system of high tension lines capable of supplying power reliably and uniformly for the entire region. They proposed as the marketing agency a new independent commission endowed with corporate powers. The War Department objected seriously. In recognition of the fight that would be encountered if he urged the committee's proposal the President chose to compromise and in early 1936 suggested that a temporary administrative

<sup>&</sup>lt;sup>1</sup> Charles McKinley, Uncle Sam in the Pacific Northwest, Federal Management of Natural Resources in the Columbia River Valley, University of California Press, 1952.

organization be set up until such time as a permanent plan could be worked out. That measure contained the following clause:

"The form of administration herein established for the Bonneville project is intended to be provisional pending the establishment of a permanent administration for Bonneville and other projects in the Columbia River basin."

An administrator of the project was appointed by and responsible directly to the Secretary of the Interior. The administrator was "authorized and directed to provide, construct, operate, maintain and improve such transmission lines and sub-stations and facilities and structures appurtenant thereto as he finds necessary, desirable or appropriate for the purpose of transmitting electric energy . . . to existing and potential markets . . . to interconnect the Bonneville project with other federal projects and publicly owned systems now or hereafter constructed." This provision laid the basis for the original grid system and for much of the administrative policy that was subsequently adopted in bringing energy to the many local distribution systems that soon were demanding power.

Since that time the sphere of the Bonneville Power Administration (BPA) "has been augmented by jurisdiction over the surplus power to be produced at several federally owned dams."

When the BPA was established, the administrator was instructed to consult with an advisory board composed of representatives appointed by Secretaries of the Interior, War, and Agriculture and the Federal Power Commission, and he was to be guided by the following general policies: to encourage the widest possible use of electric energy; to operate for the benefit of the general public and particularly for domestic and rural consumers giving preference and priority at all times to public bodies and cooperatives; no contract for sale at wholesale of electric energy either for re-sale or direct consumption to exceed 20 years' duration and any contract with a private distributor was to provide for cancellation upon 5 years' notice if the administrator believed that any part of the energy concerned was likely to be needed to satisfy the requirements of public agencies or cooperatives; in contracting with private utilities the administrator was to make stipulations which would ensure re-sale to consumers at reasonable rates.

Since that time BPA, in carrying out its power marketing functions, has been guided by the above policies. In addition, the Northwest Power Pool (a voluntary organization of public and private utilities) was formed to achieve some of the benefits of coordinated operations.

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In the organization of the Canadian portion of the basin, constitutional questions are involved which are not encountered in the United States.

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The United States government has been able to enter the business of constructing multiple-purpose dams, and of producing and distributing power, through its authority over navigable waters, under the interstate commerce clause of the Constitution and through its broad authority under the general welfare clause. Therefore, the entities chiefly involved have been federal agencies and private and public utilities; state agencies have not participated directly.

In contrast Canadian provinces have primary responsibility for water resource development. Water, like other natural resources, is owned by the provinces. The provinces have a basic responsibility over the use of water for domestic supply, irrigation, pollution abatement, stock-watering, flood control, recreation and other uses excluding navigation and the national fisheries and federal lands such as national parks. Because, by and large, the provinces own the resources within their boundaries, they must act as regards these resources as would a product-owner. As far as the Columbia River basin is concerned, all of this adds up to one significant difference from the United States situation: the consent of the province of British Columbia is required with respect to any development in the Canadian portion, while in the United States portion the consent of the affected states is not required, although they are consulted.

In British Columbia it is necessary for anyone wishing to build an obstruction or diversionary works on a lake or river within the province to obtain a license from the provincial government before proceeding with construction. If navigation is affected approval of the federal government is required under the Navigable Waters Protection act. In addition, if the river is of an international character like the Columbia, permission to construct must also be obtained from the government of Canada under certain prescribed conditions. This requirement is designed to ensure that the works to be constructed accord with the policy of the Canadian government in its relations with the United States and that Canadian resources are developed for the benefit of the Canadian people. In other words the province may dispose of the water resources of purely domestic rivers as it sees fit, but with respect to those of international rivers the province is subject also to the policy of the federal government.

In addition to having jurisdiction over international waters, the federal government has in Canada, jurisdiction over navigation and fisheries. As regards agriculture the federal government has, broadly speaking, concurrent jurisdiction with the provinces and may participate directly in water resources development to improve agriculture. In this instance the federal government could, if requested, provide financial or technical assistance to the province.

#### The Role of the International Joint Commission

Wishing to explore the possibility of further development of the Columbia, with the aim of regulating the annual flow of the river to increase the output of their power plants, the United States government asked the government of Canada to join with them in referring to the International Joint Commission (IJC) for investigation and report the various possibilities of developing the Columbia River basin. Canada accepted, and the formal "Reference" was made to the IJC in 1944.

The IJC has six members, three from the United States and three from Canada. It was set up pursuant to the Boundary Waters Treaty signed between the two countries in 1909. As with many treaties, this document dealt with a number of outstanding questions. A basis for dividing the power benefits of the Niagara River was decided upon; principles for the apportionment of the waters of the St. Mary and Milk Rivers in the Alberta-Montana boundary area were settled (the main water uses in this case were irrigation and stock-watering). The construction of dams and other works in "boundary waters" (waters forming the international boundary such as the Great Lakes, Rainy River, St. Lawrence River, etc.) was, by Article III, made subject to the approval of the IJC, unless a separate special agreement between the U.S. and Canada was made. The use of "boundary waters" was to be governed by the principle of "equal and similar rights" when the IJC made its decisions. By Article IV approval of the IIC is required also for the construction of installations below the boundary in rivers crossing the boundary, whenever such installations raise the level of the river above the boundary. Exclusive authority over the use or diversion of such rivers above the boundary was reserved by Article II to the two countries and to their constituent states or provinces, but with one proviso:

Any such action in the upstream state resulting in injury to downstream interests was to give rise to the same rights and legal remedies as if the resultant injury had taken place in the country where the obstruction or diversion occurred.

Under Article IX of the treaty, however, the IJC may be asked by the two national governments to investigate and report on any question arising between them along the international boundary and to *recommend* a course of action to governments. The Columbia River reference of 1944 is a case in point. Subsequently there was an important "application" to the commission under Article IV—The Libby Dam application. The construction of a high dam at Libby, Montana on the Kootenai River (a tributary of the Columbia) would flood an extensive area above the international boundary in Canada. The Canadian government has been unwill-

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ing to commit itself for or against the building of this dam until studies of the whole Columbia River basin have revealed the developments in the basin which would be best from the U.S. and Canadian points of view.

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The IJC holds regular executive meetings twice a year and in addition meets as frequently as necessary, to consider specific issues. When transboundary water questions are being considered the commission usually appoints an international engineering board to study and report upon the engineering aspects of any problem referred to it under Article IX of the treaty. The commission also holds public hearings to give all interested parties convenient opportunity to present their views on a specific proposal, and then considers all relevant facts and representations before preparing a report with recommendations to the two governments. If all or a majority of the commissioners have reached agreement on the matter a joint report is made to the two governments. If the commissioners are evenly divided separate reports are made by the commission on each side to their own government.

At the present time the commissioners on the U.S. section of the IJC are Douglas McKay, former governor of Oregon, chairman; Eugene W. Weber, special assistant to the chief of the Corps of Engineers, and Francis Adams, chief of the Bureau of Power of the Federal Power Commission.

On the Canadian side the men selected are all from outside the federal service. The chairman is General A. G. L. McNaughton, and the other two members are J. L. Dansereau, consulting engineer and D. M. Stephens, chairman of the Manitoba Hydro-Electric Board.

#### Basic Issues

The extreme difference between the high and low flows of the Columbia and its tributaries means that at certain times of the year a great deal of water passes unused over the spillways of the large dams in the lower Columbia. Storage and regulated flow of water in the upper reaches of the Columbia can add substantial amounts of low-cost power to the output of the downstream plants. The same storage can also provide flood protection for the lower Columbia. There could be stored in Canada, for the purpose of regulated release, anywhere from 20 to 26 million acre-feet of water annually.

There is a high degree of physical interdependence between headwater storage and downstream generating capacity. In the case of the Columbia there are wide seasonal variations in river flow, with the high flows occurring in the spring and summer months and the low flows in the winter months. The demands for electric power are usually greatest in the winter, when Columbia flows are low, and least in the summer when flows are greatest. Upstream storage can therefore be developed to store water in

the spring and summer so that it may be released to augment the low winter flows.

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If downstream plants and upstream storages are interconnected electrically it becomes possible to utilize the heavy summer flows at the downstream plants, transmit energy to the loads normally served by the upstream plants, and thus permit the latter to cut back their ouput in order to store more of the natural river flow. To take full advantage of this, plants at the storage outlets must be designed to utilize all of the dependable storage outflows in a limited period and have correspondingly higher installed capacity.

The significance of downstream power benefits relative to the at-site prime power output is illustrated by a recent study<sup>2</sup> which indicates that storage provided at the Hungry Horse site on the Flathead River, a tributary of the Columbia, can produce nearly 3 times as much prime power at the downstream plants as is produced at-site. The same general relationship applies in varying degrees to the storage possibilities on the Canadian reach of the Columbia.

Recognizing these facts, four broad courses of action are open to Canada in connection with the upper Columbia River. These courses are:

Independent development without regard to the effects downstream.
 This type of development would result in incidental benefits to U.S. plants although of a much smaller magnitude than could be realized if the developments were based on interconnections and coordinated operations.

2) A development based on interconnections and coordinated operations with the U.S. power system. If the upstream plants are regulated to take account of the requirements of the downstream plants and power interchange arrangements are used, the total power benefits can be increased by about 50 per cent. This alternative could have two variants:

(a) coordinated operation for a limited period of time, say 25 to 50 years, in anticipation of a partial diversion to the Fraser River in Canada, or

(b) coordinated operations in perpetuity.

3) A diversion of some of the flows of the Columbia and the Kootenay into the Fraser River basin, coupled with power developments in both basins. This would give Canada large amounts of energy but entails some problems.

4) No development on the upper Columbia in the immediate future. If this alternative was selected the power requirements of British

<sup>&</sup>lt;sup>2</sup> John V. Krutilla, and Otto Eckstein, *Multiple Purpose River Development*. Studies in Applied Economic Analysis. Published for Resources for the Future, Inc. Baltimore: Johns Hopkins Press, 1957, p. 64.

Columbia would be met from other sources. In the absence of a reasonable agreement on the division of downstream benefits this alternative may prove to be economic from Canada's point of view.

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In the U.S. Pacific Northwest the rapidly growing power requirements can be met in a number of different ways. Additional steam-generating capacity can be added, nuclear power can be developed or technological innovations, such as transformation of solar energy or the release of hydrogen energy, may lead to new sources of electric power. Possibilities also exist for additional storage in the U.S. reach of the Columbia. In addition to the alternatives above, the U.S. can make arrangements for Canada to provide storage and regulated flow in return for an equitable share of the downstream benefits which result.

Looking at the alternatives open to the U.S. and Canada there is one which is common to both, namely coordinated development. It will undoubtedly be assessed carefully before either country decides which course of action is most advantageous from a national point of view. In assessing the alternatives (including the variants cited above) both countries will need to determine two questions:

1) What is the nature and extent of benefits which would accrue in the U.S. and Canada as a result of a coordinated development?

2) What share of these benefits in the U.S. should be returned to Canada in return for storage and regulated flow?

Organization for Basin Development-Factors to Consider in the Columbia River Case

In view of the various possibilities open to Canada, organization for basin development would depend on whether the two countries—Canada and the United States—were involved, or whether the Canadian and United States portions of the basin were developed independently. In the second case, organization in Canada would involve, on the government side, only the provincial government of British Columbia and the government of Canada. In the first case, these two governments plus any entities on the United States side would be included.

In the U.S. the need for comprehensive planning for the multiple use of water resources has become an undisputed fact. Canadians are only now fully realizing the implications of such an objective. Canada is now entering the stage of development where the pressure on available water supplies for domestic, recreation, power, agriculture, industrial, navigation and other uses is becoming acute in some areas. This is particularly true in areas such as southern Ontario, Saskatchewan and British Columbia. It may be expected that as this trend continues more attention will be directed toward research and planning for the comprehensive development of the land and water resources.

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The TVA experience is recognized by people throughout the world as a successful experiment in unified comprehensive development of the land and water resources of a river basin. While the general principle underlying the TVA development is recognized, there is not the same degree of agreement on the desirability of using the same type of organization in other river basins. The lack of agreement can be attributed to conflicts between private and public interests as well as the attitudes of existing federal agencies. In addition, it should be recognized that no two river basins are alike in physical or cultural characteristics thus making it impractical to transfer an organizational pattern from one area to another without major adaptations. There are, however, certain considerations which are basic to the comprehensive development of any river basin or basins.

If a program of development is to be successful the people in the region most directly affected must participate actively in the decisions respecting the development of these resources. The people whose lives and aspirations are closely tied to the development of the physical resources of a region should play a major role in all decisions affecting the development of these resources.

The technical studies required for sound development of any river basin should be conducted by scientists who can appraise dispassionately the potentialities of the river system. The necessary studies on engineering, forestry, agriculture, recreation, etc., should, insofar as is possible, be divorced from the policy consideration. In other words when the policymaker reads an engineering document on the physical potentialities of a given river basin he should be confident that the study is endorsed by an agency having a reputation for the objectivity and soundness of its engineering studies. Policy decisions should then be made by those in government who have the responsibility and authority for making these decisions.

When the necessary technical studies are in hand, one can expect that policy decisions will be based on a careful study of these facts in relation to the various interests affected by the proposed development.

The administration of a river basin development must be so organized that responsibility is assigned to a specific group of individuals who can be held accountable for results. Conflicting and overlapping jurisdictions make it difficult for the public and legislative groups to know precisely what specific agency of government is responsible for actions taken in a given region.

The Premier of British Columbia has recently stated that, if there is a satisfactory settlement of the downstream benefit question, development of the Columbia River in Canada will be by a public agency. The agency could be a public corporation financed entirely by the province or in cooperation with the federal government.

If it is decided that some form of coordinated development is desired,

then benefits can be fully realized if an effective arrangement is made to coordinate the operation of the reservoirs and power systems in the two countries. The agency in each country must have authority to coordinate its operations with those of the other in such a way that the over-all benefits will be maximized for the mutual advantage of both countries.

# DISCUSSION: ORGANIZATION FOR RIVER BASIN DEVELOPMENT—THE COLUMBIA RIVER

STEPHEN C. SMITH University of California, Berkeley

Kristjanson has given us a good, short review of some of the international problems in organizing the Columbia River basin. Although his paper is cast in a commendably temperate tone, I have the feeling from other sources that the issues between the two countries are sharply drawn in the minds of some who have concerned themselves with these problems. These people have affirmed the doctrine of territorial sovereignty as expressed in Article II of the Boundary Waters Treaty of 1909. This doctrine should be contrasted with the principle of "equal and similar rights" as expressed in Article VIII of this treaty. The latter principle is not the relevant issue in the Columbia basin as it refers to rivers which themselves form a boundary. This distinction between the two sections should be emphasized. According to Article II, the doctrine of "territorial sovereignty" applies to rivers which flow across the boundary. Thus the significant question relates to whether this doctrine or some other is most appropriate. The alternatives which could be applied are riparian rights, prior appropriation, or equitable apportionment.

Certain Canadians with good trading skills are vigorously playing this aspect of the bargaining process in asserting their right to dam or to divert. With similar intent, the government of British Columbia is seeking alternate power sources, for example, the Peace River. By taking this position, the power drops on the Columbia River can be left undeveloped until a good bargain for repayment for downstream benefits is struck. To properly interpret such actions, one must realize that both British Columbia and the Canadian federal government have an essential voice in the disposition of Columbia River water north of the United States border. In addition, British Columbia is fully within its rights to develop alternate sources of power without concerning itself with the channels of international relations which flow through Ottawa and Washington.

On the United States side, Kristjanson correctly points out that the federal government has taken the lead in representing those interests advocating coordinated river development and the construction of large-scale

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the feds advoge-scale multipurpose projects. But the situation as it involves these negotiations should not be unduly oversimplified by only noting that the "entities chiefly involved have been the federal agencies and private and public utilities." Of course, the national government is the organization through which many of the complex United States interests find their main representation. The agencies of the Bureau of Reclamation, the Corps of Engineers, the Federal Power Commission, and the Bonneville Power Administration are directly concerned. Through agencies such as these the businessman and the farmer have sought to use the federal government in the development of the Northwest. These agencies in turn were created by legislative action, and they report upon their activities to the congress. These agencies are generally familiar to the people in the Columbia River basin as well as throughout the nation. But a little known organization holds a key position in these international conflicts of interest. The International Joint Commission has played a signficant role on both sides of the border. Kristjanson has mentioned the 1944 Columbia River reference and the United States application to construct Libby Dam and thus flood approximately 15,000 acres of Canadian land. However, he did not elaborate upon the problems involved in using this particular treaty and commission other than to note that several significant agreements have been consummated since the treaty has been operative. Nor has he attempted to apply some of the "principles" of organization which are presented in the last section of his paper.

Scholars in the field of international law in both Canada and the United States have scrutinized the application of the provisions of this treaty to the Columbia River. Yet the legal analysis of these international institutions generally has not shed light on their ability to come to grips with the regional problems of the Northwest. In like manner, formal economic analyses have avoided questions of this type. Certainly the question should be raised as to whether other types of analyses might not be

appropriate.

An important point to be raised in the analysis of these problems is the manner in which the complex interests are brought to focus upon the policy questions through the Joint International Commission. It should be noted that under the operation of the Boundary Waters Treaty with Canada the three United States commissioners are appointed by the President without the benefit of senatorial review and approval. With their authority based upon such an appointment procedure, the ability of the many interests to have a voice in the selection of these key personnel is severely restricted. Of course, the commissioners may be questioned by Congress in budget and other hearings, and any agreement which is proposed must pass the tests of the State Department and the Senate. Yet, this is too late. Negotiations have taken place. Senatorial approval would mean that a

public record could be obtained which would relate the commissioners to a broader base of interest which exists at both the national and regional levels. The performance of this function of representation, however, does not necessarily mean that federal agencies with a particular interest should be directly represented on such a commission. In fact, the reaching of an agreement concerning the development of a major international river would seem to call for the assumption of a broad area of responsibility-broader than any one agency or interest. Time does not permit a detailed analysis, but the question should certainly be posed as to whether the Commission under the Treaty of 1909, with its attendant pattern of organization, provides an appropriate institutional framework for making these decisions.

Another factor on the United States' side is the possibility of creating a federal corporation to act as a marketing agency for federally produced power. With the existence of such an agency, one organization could speak for the Northwest's power interests. Kristjanson has noted that the Premier of British Columbia advocates the establishment of a public development corporation after the boundary question has been settled. He also makes partial mention of problems associated with this idea on the American side. With both the Republican and Democratic candidates for the governorship of Oregon supporting the idea, progress in this direction may be somewhat more rapid. In considering the role of such an agency, it should be thoroughly explored as to whether the corporation should be created in advance of settling the negotiations with Canada. Positive action in this direction would be in contrast with the apparent position of the British Columbian government.

Finally, a comment on Kristjanson's point that "the necessary studies in engineering, forestry, agriculture, recreation, etc. should, insofar as is possible, be divorced from the policy considerations." If this statement is taken literally, we run into the grave danger of having our research irrelevant to the policy questions. This is a danger we can ill afford if possibilities of avoidance exist. To say this does not mean that these studies should ignore their professional integrity. On the contrary, the various professions have an obligation to see that their standards are maintained. One often ignored criterion to be used in formulating our research questions is their

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Chairman: Robert C. Tetro, Foreign Agricultural Service, USDA

## COMPETITION IN INTERNATIONAL TRADE WITH PARTICULAR REFERENCE TO AGRICULTURAL COMMODITIES

S. C. HUDSON AND RANDOLPH GHERSON Canadian Department of Trade and Commerce

Competition in international trade is a live issue not so much because of the expansion of monopolies or cartels or oligopolies, although these now pervade the world farm economy in one form or another, but because of the advent of government intervention in economic affairs, both at the national and international levels. The profit motive of the individual trader has been superseded by national priorities and there results inequality of competition among governments or government-sponsored agencies which affects the international movement of agricultural products, often not without friction.

The purpose of this paper is to attempt an appraisal of competition in the international trade of agricultural products, and to point to some of the issues which arise within the context of present international distribution arrangements. It may be useful, therefore, in broad terms, first, to define competition in its theoretical sense and the premises upon which it is based; secondly, to consider how practice as a result of fundamental changes in the world economy has diverged from theory, and to explore some of the factors which might be responsible; and finally, to discuss certain implications of the current situation, should international agricultural trade persist along its present lines of development.

### Competition in Theory and Practice in the Pre-1914 Period

In general theoretical terms, perfect competition in international trade would presuppose the operation of a world free market in which all countries compete on an equal basis, the free convertibility of currencies and the unrestricted and unregulated flow of goods and services from the most efficient producer to the highest bidder; price would exercise a regulatory function in registering and, in turn, influencing the adjustment of supply and demand; trade would be transacted on a multilateral basis; and there would be complete mobility of capital and labor resources. The multilateral trading system implies both the unrestricted distribution of goods and the transfer of payments, including interest and dividends on account of overseas investments, in the settlement of trade balances. This system would purport to supply countries with currencies or credit balances for the purchase of goods and services outside the scope of bilateral exchange

or barter, and also to enable credit balances with one country to offset deficits with another. The function of competition is, therefore, the development of complementary relationships in trade in accordance with comparative advantage and the best and most efficient allocation of resources. An essential factor in this system would be "perfect knowledge by traders in each country of the conditions of supply and demand and the consequent ratio of exchange" and "perfect and continuous intercommunication."

This concept of competition in international trade was in the main developed by the classical school of economists on the basis of the evolution of international trade in the nineteenth century. Perfect competition in international trade was the ideal: the Benthamite school believed that this would bring "the greatest good to the greatest number"; but, as Adam Smith pointed out in his Wealth of Nations, this whole concept rested on the assumption that there was a "harmony of interest" among trading nations and that "the pursuit of enlightened self-interest was in the interest of all." However, in the real world of nation-states, of uneven distribution of geographical, natural, climatic, population, capital and technological resources, perfect competition in international trade has never been absolute. The priority of national considerations, political, social and economic, above all others and the relative inertia today of capital and labor, as compared with the significant impact of migrations and investments over overseas in the nineteenth century, have overcome free competition.

It should perhaps be noted at the outset that agricultural products and the factors that affect their output are peculiar. Soil conditions, climate and the biological nature of agricultural production affect the whole process of adjusting supply and demand in a way which could vitiate normal economic responses in a given situation. For this and other reasons, the function of competition or free market prices on agricultural products entering world trade have immediate social and economic effects on the farm economy. Whereas the output of industrial goods or of nonagricultural commodities could be regulated in response to demand conditions, the farmer has little control over his crop once it has been sown, and even after it has been harvested he is often less ready to shift from, say, grains to dairy and livestock products than a manufacturer is to shift from one set of goods to another; and the farmer is more closely tied to his land than the factory hand or manager to a particular industry. This would suggest, therefore, that the farmer and the farm economy as a whole are particularly vulnerable to the operation of world free market forces.

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<sup>&</sup>lt;sup>1</sup> Stanley Jevons, Theory of Political Economy (3rd Edition), p. 37 and F. H. Knight, Risk, Uncertainty and Profit (Reprint by the London School of Economics), p. 78.

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appear to be two underlying premises: the first is the function of price; and the second is the unrestricted flow of goods and services contingent upon the multilateral settlement of trade and payments balances. While these premises may be said to be fundamental in free market conditions, it is a matter for consideration whether, after the experience of two world wars and their effects on individual economies, they are still operative.

In the period preceding World War I it could be claimed in general terms that the conditions of an expanding world economy did not belie these premises. There was one world market. International transactions relating to individual commodities, such as tea and sugar, or a cognate group of commodities, such as grains, were carried out through exchanges of futures markets. The price of, say, one particular grade of wheat in Liverpool was quoted almost simultaneously in Chicago, Winnipeg and Buenos Aires, registering expecations of supply and demand. Fast intercommunication and knowledge of the market was as perfect as scientific devices then could allow. Moreover, there as an effective international payments system in operation based on gold.

## The Impact of World Economic Conditions on International Trade, 1920-39

The changes in the political boundaries and the problems of economic unsettlement in the aftermath of the World War I influenced a greater measure of government regulation in trade. With the drastic fall in agricultural and food production in Europe, the largest importing area, all duties were relaxed. With the loss of Russia and eastern Europe as important sources of supply, Europe's food requirements, particularly grain were being met to an increasing extent from Canada and the United States; but the dislocation of the prewar system of settling trade deficits accentuated by problems of reparations meant that an appreciable proportion of Europe's food and agricultural imports would not have been possible without the extension of large loans. It is during this immediate postwar period that government measures which had been inrtoduced during the war were being maintained for the then new purposes of balance of trade and payments, and the feeling of insecurity following the vicissitudes of a great world war gave further edge to the tendencies towards self-sufficiency and protection.

In the period 1925-29, when the war-stricken areas of Europe had achieved a measure of recovery and protectionist tariffs were restored, there was a relaxation of government controls and an increasing use of commercial treaties, which were inspired by the desire to recreate the conditions of free trade and free exchanges of pre-1914 by agreeing to lowering the level of duties. This movement towards tariff reduction, however, concentrated on industrial goods, tariffs on agricultural produce be-

ing maintained and reaching their peak in 1929, when they stood as high as 30 per cent or even 40 per cent ad valorem.

The collapse of the world grain market in 1929 ushered in the period of the Great Depression, 1929-33. The main developments of this period which affected international trade in farm products were the devaluation of European currencies and the disruption of the international exchange system, and the intensification of government intervention in agriculture associated with security and welfare legislation to protect the farmer from the risks of undisciplined market forces. This in turn led to complementary measures in the field of production and trade. In importing countries in Europe, the world's major market for grains and food products, policies aiming at self-sufficiency prevailed; in exporting countries, state-sponsored agencies undertook to assist in the marketing of grain and other farm products for export and assured the producer a minimum return on his crop. Importing countries raised their tariff barriers against imported grain and food imports. The credit crisis of mid-1931 in Europe followed by the United Kingdom's departure from the Gold Standard meant the breakdown of the system of trade relationships and commercial settlements that had been tenuously held together since the end of the war. New expedients made their appearance: import quotas and licences, currency restrictions and marketing monopolies. Such was the effect of these measures, in which the regulation of trade in agricultural products were most stringent, that the U.S. Senate Enquiry on World Barriers in Relation to American Agriculture, in 1933, reported that "the restrictions to international trade upsurged in this period have been carried beyond any point ever before attained in modern peace times."

The combined effect of policies of self-sufficiency in Europe, together with protective measures, discriminatory and restrictive trade regulations and the inconvertibility of currencies made themselves felt in the period 1934-38. The universal market, the most-favored-nation treatment, and triangular and multilateral trade relations gave way to regional and bilateral trade agreements determined in the main by trade and payments balances. The duration of trade agreements became much more limited, from the order of 12 years or more in the period pre-1914 to three to five years, because of the instability of currencies. Trade relations between the United States and Europe fell drastically following the retaliatory tariffs imposed in the United States on the import of foreign goods. This in turn led to an acute dollar and gold problem in European countries which earned their exchange from the sale of their manufactures to pay for the import of dollar commodities.

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World War II and the immediate postwar period accelerated and strengthened the trend towards government regulation in agriculture, and, as in the period following the Great Depression, the international effects of measures affecting production projected themselves in trade relations which were chiefly on a government-to-government level and were at the same time circumscribed by exchange control. The machinery of economic planning called for in the pursuit of the war effort left almost all governments in virtual control of the economic life of their countries. Of all the countries which were involved in the war, only the United States emerged with the financial and economic power to enable the rehabilitation of countries whose economy and resources had been exhausted. Grants and loans to individual countries from the United States and to a lesser extent from Canada, followed by the Marshall Plan for the economic recovery of Western European countries and their dependent territories overseas, accompanied by a European multilateral payments system, made possible a return to normal trading relationships.

The economic situation in most countries in the immediate postwar period of reconstruction urged the husbanding of resources and entailed the continuance of a measure of economic planning. The experience of two world wars influenced the maintenance of policies of self-sufficiency. Policy thinking in most countries seemed to be influenced by the fear of the recurrence of the economic depression of 1929. There was a tendency, therefore, to rebuild national economics on lines which purported to avert such a recurrence. Economic planning was based on full-employment policies, and welfare legislation aimed at protecting the economy, including the farmer. Trade was largely under government control, and in many cases bilateral agreements, including barter, were complemented by licensing procedures, quotas and exchange restrictions. From the end of the war to about 1952 there was a renewal of the trend towards economic independence and protection, and, as a result, world movement in agricultural products lagged far behind trade in industrial goods.

On the other hand, there was evidence of attempts at the inter-governmental level, also influenced by the economic depression, to cooperate and consult through the establishment of international and regional organizations such as the United Nations, the Food and Agriculture Organization (FAO), the Havana Charter and the General Agreement on Tariffs and Trade (GATT), and the International Wheat and Sugar Agreements, the Organization for European Economic Cooperation (OEEC) and other formal and informal regional organizations relating to trade and economic cooperation. Although this form of intergovernmental cooperation resulted in some progress towards freer trade and payments on a

regional basis, its multilateral impact has been limited by the divergence and incompatibility of national policies because of the altered economic conditions in the second postwar period of 1950-55 and thereafter.

The main fundamental changes affecting international trade in agricultural commodities following World War II were (1) the quasi-permanence of government regulation and the inertia of market forces; (2) the inconvertibility of currencies between the major supplying and consuming areas; and (3) following the emergence of the surpluses in farm products, particularly grain, the recognition of a vast area of potential and unsatisfied demand in the economically less-developed countries which lack the means of making this demand effective.

First, the undertaking of responsibility by governments to protect the farmer in both exporting and importing countries had led in the 'thirties to the establishment of producers' marketing boards. In the period preceding the war, when grain marketing was still influenced by futures markets, reflecting expectations of supply and demand, these boards in exporting countries sold the crop purchased from the farmer at prevailing world prices. Since the end of the war, farm products have been marketed by these boards, in certain cases in conjunction with the private trade, on the basis of their independent assessment of the best price obtainable.

To a large extent, the world agricultural economy is currently divided into autonomous domestic markets sheltered against outside influences. Domestic price formation in many instances is largely divorced from prices at which international trade in agricultural products is transacted. These circumstances have tended to inhibit the function of price as an agent of competition in the traditional commercial sense, and as a determining factor in bringing supply and demand into equilibrium.

As an external consequence of this government regulation or influence at the national level, trade in agricultural products is further subject to various promotional, restrictive or protective devices. Exporting countries subsidize exports, sell on concessional terms not recognized in normal commercial practice, and impose import restrictions; importing countries apply quotas, levies, currency control and multiple exchange rates and traiffs.

Secondly, most countries outside North America employ trade restrictions to safeguard their balance of payments positions. North America does not absorb all the goods and services from other countries which are required to pay for their imports from North America, partly because of trade barriers and also because output and productivity in these countries, particularly in the immediate postwar years, has not always been sufficient to meet the demand in North America for certain imports. These conditions have led to the re-emergence of quantitative import restric-

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tions, and to an increased use of state-trading, to conserve foreign exchange resources or to redress maladjustments in international payments. With the priority allocated to imports of capital goods for economic reconstruction and development, more food was required to be grown at home. This would account in part for the higher rate of development in trade in manufactured goods as compared with that in food and foodstuffs since the end of World War II.

Bilateral trade and payments arrangements were entered into to allow for the exchange of goods, particularly grains and foodstuffs. While in a sense these trade and payments arrangements may have helped to ease and foster trade relations after the war, particularly between Western and Eastern Europe, they have also tended to harden the pattern of trade between particular countries. Countries outside the Dollar Area formed regional currency areas to promote convertibility and multilateral trade. In Europe, the European Payments Union (EPU) was formed to enable member countries to withstand a trade surplus or deficit instead of seeking an exact balance in trade and payments. The Sterling Area, which formally came into existence during the war, has been maintained as a multilateral trade area with slight internal restrictions in operation. This permits purchases by one member with adverse trade and payments balances with dollar or other "hard" currency areas to be corrected by the exchange earnings of other members. The "Paris Club" which came into being in July, 1956, was to enable countries to use credit balances with Argentina in trading with each other as well as with Argentina. There is also a similar arrangement between Argetina and neighboring Latin American states. But while there has been appreciable progress made towards easing restrictions within currency areas, there have also been significant relaxations in the discriminatory and restrictive measures affecting trade between currency areas as in the case of the Dollar Area with EPU and with the Sterling Area.

Lastly, the complex of national measures affecting agricultural products and the extensive application of scientific and technological advances to production, also in the main promoted under the aegis of governments, have led to high levels of output in exporting countries; in grains, for example, this was particularly in evidence under the exceptionally favorable weather conditions in 1952/53. In the leading importing countries in Western Europe, corresponding developments took place urged by the desire for self-sufficiency in food and the need to conserve foreign exchange resources. Potential demand for grains and foodstuffs in less-developed areas, which would absorb part of the surplus lacked purchasing power, and any foreign exchange earned was usually earmarked for the import of goods and services for economic development and explan-

sion plans. In order to avert the disaster of the 'thirties, following the emergence of the grain surplus, the major grain exporting countries maintained the international price at levels higher than those to which it might have fallen under free market conditions. This situation has led in turn to unlateral measures of surplus disposal, concessional sales and long term credit.

#### Government Measures Affecting Competition

Against the background of these developments in the world agricultural economy, it may be useful to consider briefly the measures currently regulating the flow of trade and the manner in which they affect the entry of exports into importing countries and competition among exporting countries. The two most important devices used both by exporting and importing countries alike in controlling trade are state-trading and bilateral agreements. The common feature of these two devices is their monopolistic nature; both devices in the main are based on the assumption that the government or its agencies are a determining factor in the best allocation of resources and in consumer choice. Although governments cannot be indifferent to price movements and the supply and demand position, their decision to buy or sell on a state level is not always determined solely by economic or commercial considerations.

State-trading may include the procurement of imports or the marketing of exports by government departments or state-sponsored agencies. It usually involves control of imports and exports, the government or state-sponsored purchasing or marketing agency deciding the level of import requirements or the surplus over production available for export. Transactions within the Soviet bloc countries and between these and other countries are the best example of state-trading. In certain cases, e.g., in Germany, state-trading allows for the actual buying and selling by private traders and limits itself to the maintenance of a reserve and the levying of differentials which may be equivalent to flexible import duties. The exchange of goods by barter is frequently concluded between state-trading nations. One of the features of such transactions is that the price of the export or import product is more often related to the discount or premium placed on the other commodity or goods received in exchange rather than to the prevailing market value.

Bilateral trade and payments arrangements are also commonly associated with state-trading. The main purpose of this type of agreement is the purchase in exchange, or part exchange, of commodities for goods or for "hard" currencies. Most of these agreements are designed to limit or prevent trade or foreign exchange deficits with individual countries. They quote definite quantities which the parties agree to buy or make available for export; often the total quantities and/or values of various commodities

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exchanged are stipulated only to the extent that licences for import or export will be granted. It should be pointed out that in many cases there is no obligation on either party to import, or export, all or a proportion of the quantities involved: notable examples—though quite different in kind—are the agreement on grains and other agricultural products between Austria and the USSR and the "best endeavor" type of agreement between the United Kingdom and Australia. In other instances a percentage of a country's import requirement is committed, as in the recent case of Japan's undertaking, while on a competitive and non-discriminatory basis, to cover about 30 per cent of its barley import needs from Australia.

Again using grains for purpose of illustration, it may be seen that the bilateral trade and payments arrangements play an important part in international trade largely because the Dollar Area is the main source of supply.1 For instance, in the period 1951 to 1957, 243 bilateral agreements affecting grains were contracted involving 54 countries (of which 11 Communist Bloc countries among themselves entered into 22 agreements): there were included 97 agreements between countries in the Free World, and 103 agreements involving Communist bloc exports to the Free World. On an annual average, 35 agreements involving 29 countries were in operation, (of which 29 agreements involved 20 countries in the Free World). In the absence of actual figures showing the distribution of trade under each agreement, it is very difficult to assess the precise effect of these bilateral agreements. These agreements make trade possible, in others traditional patterns of trade are confirmed; but, in the light of the number of agreements among countries of the free world (excluding the Dollar Area), it is evident that considerations of foreign exchange and trade balances are of paramount importance. In most cases bilateral agreements include provisions for the extension of credit and the settlement of accounts, or for other financial arrangements connected with the settlement of extraneous international transactions. While these agreements help to overcome the restrictions applied by importing countries, they do allow exporting countries whose products can be bought for soft currencies to acquire a quasi-monopoly position. A case in point is the brisk trade in wheat flour exports from Germany and the Netherlands within Europe and overseas. Another example of agricultural importing countries being tied to a source of supply, thereby cutting off competition for other exporting countries, is Argentina. Under 54 bilateral agreements entered into from 1947 to 1957, Argentina imported a large volume of capital equipment, goods and services in connection with her economic development plans in the immediate post-war period whereby Germany, Italy, the United Kingdom, Brazil and Switzerland, to name only a few, built sub-

<sup>&</sup>lt;sup>1</sup>The Dollar Area accounts for about two-thirds of the world's grain exports.

stantial credit balances with Argentina. In order to use this credit in pesos these countries have been in a sense constrained to import grain and livestock products from Argentina. The "Paris Club" Agreement has widened the scope of these arrangements by allowing trade among Argentina's creditors against trade balances held in Argentina.

In restricting, regulating or preventing the entry of agricultural products, importing countries, in particular those subsidizing production, apply a variety of measures in order to deny any competitive advantage which exporting countries may have. These include tariffs, import quotas, import levies, compulsory use of domestic grain for milling, multiple ex-

change rates and currency control.

Traditionally tariffs have been the most common measure of regulating trade. Usually they take the form of a tax or duty imposed by the import. ing state on products entering the country. The object may be either to restrict imports as a measure of protection or to raise the national revenue and, incidentally, help pay for subsidized production in which case it acts as an equalization fee or import levy. Protective tariffs, though affecting imports, do not prevent the price of imports from moving in accordance with price changes prevailing in the world market. The operation of the equalization fee or import levy on wheat in Germany, for example, is such that the German miller is encouraged to export flour from imported grain on terms that enable him to undercut traditional exporting countries.

Quantitative import restrictions which place a definite limitation on the quantity that may be imported are often allied to exchange control and, in certain instances, to state-trading and bilateral trade and payments arrangements: in such cases quantitative restrictions are apt to be discriminatory. The compulsory use of a proportion of home produced grain in milling also acts as a quantitative import restriction, particularly where the percentage of native grain in total supply is very high as in Belgium

and Germany. Multiple exchange rates involve the application of different rates of exchange charged as payment for imports of goods depending on whether or not they are "essential." This differential treatment applies not only when agricultural products are regarded as "essential" at a given rate of exchange, but also to the currency in which payment may be made. 8everal importing countries in Latin America, the Near East and Asia apply this technique to imports and exports according to whether the currency of payment is at a premium.

Exporting countries apply in the main export subsidies, surplus disposal measures and sales on concessional terms. The measures currently in operation derive from a surplus situation and would not necessarily have assumed such significance in times of scarcity. Export subsidies normally represent the difference between the higher guaranteed price to the home

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producer and the lower export market price. The purpose of such subsidies is, of course, to undercut competing exporting countries in the market and to facilitate the entry of exports in importing countries. In the prewar period such devices, which are akin to dumping, were discouraged by the imposition of countervailing duties in importing countries. In the context of the present world agricultural economy, however, where importing countries themselves protect their own agriculture with restrictive trade practices, such duties often tend to be superfluous. On the basis of present production policies and a surplus situation in a number of agricultural commodities, there will be continuing pressure in exporting countries that they be maintained.

Measures of surplus disposal have introduced a new type of competition in export trade, both in aim and scope. These aim to assist in the disposal of stocks of grain or other agricultural commodities which are surplus to both normal export marketings, domestic consumption requirements and national reserves. The main impact of surplus disposal measures on the international movement of grains may be attributed to the U.S. Agricultural Trade Development and Assistance act of 1954 (P.L. 480). These measures fall under three heads. Title I concerns the sale of surplus agricultural products, including grains, against local currencies. Title II authorizes the donation of agricultural commodities for famine or other emergency relief purposes. Under Title III authority is given to barter stocks of surplus commodities for strategic and other materials required by U.S. government agencies. These measures are designed particularly to promote export trade and to assist in the economic development of the less-developed countries: while they have added to consumption in areas where little or none could have been afforded, in certain instances, particularly barter sales, they have had an adverse effect on the normal trade of other exporting countries and, indeed, also replaced some United States potential cash marketings. Changes in the regulations relating to barter, including proof that barter transactions were additional to normal marketings and the provision for global quotas covering the usual imports from other suppliers, have greatly reduced the competitive impact of this program during the past year.

Although there is a movement to ease the restrictions on trade within currency areas or trading blocs such as in the European Common Market or the projected European Free Trade Area and the proposed Customs Union in Latin America, and although attempts are being made to relax measures affecting trade between currency areas, it is probable that so long as international insecurity and tension prevail in world affairs, the tendency toward self-sufficiency in traditional importing countries is likely to be maintained. While these countries claim that their settlement of payments balances is subject to foreign exchange difficulties—also a factor in policies

of self-sufficiency-trade and payments arrangements is likely to influence the direction of trade and restrict the entry of agricultural exports, It would seem, therefore, that so long as the factors underlying and motivating national agricultural policies continue along their present lines of development, government control, regulation, protection or influence will continue to affect the international movement of agricultural products, Competition in world trade will remain unequal and imperfect and susceptible to national political considerations. While the area of effective demand is restricted to those countries that are not seriously affected by adverse balance of trade and payments problems, competition in international trade is severely limited in scope. In the area of potential and unsatisfied demand where there are open market possibilities, the competition between agricultural exporting countries is unequal in the sense that the ability of each exporting country to help develop this area into effective commercial markets is related to its economic and financial strength.

The protection afforded to the farmer, accompanied by complementary restrictions affecting the movement of trade, has tended to freeze those forces of adjustment in the regulation of supply and demand which operated in the free market system. The tighter and stronger the measures of protection, price guarantees and state-marketing, the lesser the opportunities and the narrower the scope for competition. The real problem which the present state of international trade poses is how to impart elements of resilience, flexibility and adjustment which appertain to the free market system without prejudicing those measures of stability introduced

The question may be asked—is it altogether impracticable to hope for a measured return or approach towards multilateral complementary relationships in world agricultural trade based on some acceptable criteria of comparative advantage? A recognition of the important part played by national agricultural policies in the present inequitably competitive situation in international trade in agricultural commodities and effective intergovernmental consultations could, and should, offer possibilities of stemming the tide of bilateralism and, by the injection of a greater degree of flexibility, of achieving a freer movement of agricultural commodities in international trade.

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### DEVELOPING INTERNATIONAL INSTITUTIONS TO GOVERN TRADE\*

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WILLIS C. ARMSTRONG United States' Embassy, Ottawa

INTERNATIONAL trade is so complex and extensive that it is difficult to know where to start this discussion. History is filled with examples of attempts to use government power to improve one's terms of trade. For example, the first instance of a coherent foreign economic policy in the United States was that of the first Washington administration, when the policy was to seek the removal of restrictions on United States exports imposed by England, France, the Netherlands, and other countries, and at the same time to place restrictions on imports from other countries so as to stimulate the development of local industry. This, of course, was a long time ago, and has presumably little or nothing to do with present

policies of either the United States or Canadian governments.

During the 19th century there was a relatively brief interval when the doctrine of free trade made considerable headway. This doctrine had both national and international applications. It was the view of the Victorian economists and businessmen, particularly the successful ones, that laissez faire economics brought the best returns to individuals and to the economy as a whole. International trade occurred in large part as a result of genuine economic advantage, and England led the way to expanded trade, lower barriers and the theory of the better mouse trap. A great deal of development of the world economy occurred as the result of the liberation of economic forces which attended this effort. Governments regulated international trade almost solely by tariffs. Governments did not fix exchange rates or manage currency; convertibility was taken for granted. If people lost out in an economic struggle, their plight was not commonly attributed to Presidents, Prime Ministers, or Secretaries of State.

This 19th century world of supposedly automatic economic adjustment is now often regarded with nostalgia, and there is much shaking of heads over the fact that government intervention in many areas of economic life has come to be the accepted pattern. We must, however, bear in mind that the 19th century, while perhaps pleasing to the classical economist and the successful entrepreneur, did not yield comparable satisfactions to the general population, who were frequently afflicted by poverty, unemployment, no medical care, bad housing, starvation wages, and a lack of social responsibility on the part of both employers and govern-

<sup>&</sup>lt;sup>9</sup> Paper represents personal views of author, and not necessarily U.S. Government views.

ments. Agriculture generally thrived, because population was growing rapidly, and new lands were being opened. Much agriculture was of the subsistence type, unaffected by business cycles, but not yielding much income.

Social consciousness and the view that man ought to be able to control his economic environment are at the root of the basic change from laissez faire economics to the modern welfare state. It is now taken for granted in most modern states that the government will have something to say about hours of work, wages, prices, conditions of trade, public transportation, utility rates, and the general level of business activity. In degree there are many differences, but in fact the pattern is almost universal in developed countries, and the idea is established in the less developed.

In no area has government intervention proceeded so far as it has in agriculture. Governments attempt to determine prices of agricultural products by promoting and reducing production, they stimulate exports and prevent imports, they encourage certain crops and discourage others, they retire land from service and they build irrigation works to bring land into service. Wherever one turns in agriculture, one encounters the government. This is perfectly natural, because the laissez faire economy is harder on the producer of primary products than it is on the producer of manufactured goods. Furthermore, farming is more subject to the vicissitudes of weather and natural disaster. Traditionally the farmer has been a person less insulated against outside economic forces, and therefore more "entitled" to protection and assistance, once a policy of this kind is undertaken. The governments of the United States and Canada have both devoted very substantial efforts and resources to improving the situation of the farmer. Farm populations in both countries are percentagewise smaller than they used to be, and this is a perfectly natural result of improved productivity in agriculture. But in the remaining farm populations, the efficient producers are very well off materially. Rural isolation has in large part disappeared, and the grinding burdens of life on the farm have been much alleviated.

In other lines of activity government intervention has also greatly expanded, driven by social consciousness, popular pressure, technology, and the idea that the standard of living should be legislated. This process has been speeded by the international situation and the experience of two world wars. Thus we must refocus our attention, in an economic sense. According to classical economic theory, individuals were economic units operating in a free economy according to the law of comparative economic advantage. We now have to look increasingly at the international economy as an area where individual national economies are operating as economic units. This is especially true with respect to certain agricultural staples such as wheat, cotton, rice, and sugar. Even in areas where total state

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control is lacking, countries have to balance competing demands of various internal economic groups, each clamoring for some kind of action in the international field. A government therefore must make a judgment based on its view of the totality of its economic interests, and of its international political interests as well.

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When governments take this broader view, they are forced to cease acting solely to satisfy the demands of one or another group of citizens. Thus a country with a diversified economy, by virtue of the pattern of its resources, has a basic need to export certain things and to import certain things; it will have to take account of its total economic relations in making a judgment on a specific question. Endless examples of this sort of thing can be found in the relations between Canada and the United States.

The fact that governments must take positions of assessing their total economic and political interests tends to make the range of international topics and issues far more extensive and complex than it was before. When nearly all business transactions in international trade occurred between individuals, governments could conveniently stand aloof. When, however, governments themselves are trading, or when they are using control measures more positive than a tariff, they inevitably come to collide with each other. Furthermore these collisions of interest are by no means limited to individual pairs of countries. In fact two countries may seek by agreement to solve their problems by exporting them to third countries.

Just as individuals wish to improve their terms of trade with each other, so do individual national economies struggle to improve their terms of trade. They have at their disposal a great variety of weapons, the effectiveness of which depends primarily on the economic strength of the country concerned. Given the concept of sovereignty, and the possibilities for national government action in the economic field, it is perhaps a wonder that international trade has been characterized by so much harmony. This development must in large part be attributed to the fact that governments have proceeded in enlightened self-interest, recognizing the wisdom of cooperation. This leads to the primary object of our discussion.

The inadequacy of individual national actions in an interdependent world has caused the establishment of a very large number of general and specialized international agencies. In part the demand for international agencies, or for internationally agreed approaches to common problems, arises from the feeling of economically weaker countries that they cannot improve their economic position without some restraint on the part of the more powerful economies, or without the assistance of the economically strong. In large part also it arises from a recognition by the more

powerful of the fact of economic interdependence and of the moral

responsibilities of membership in a world community.

There is here a parallel between the individual economic man of laissez faire theory and the individual nation state. Laissez faire economics is unthinkable as between individuals unless one assumes the existence of a moral code under which contracts are observed, commitments honored, and property rights protected. The function of government in the period of dominance of laissez faire theory was to be the good umpire who saw to it that everybody played according to the rules. The rules had their origin in Roman law, in English common law, and in a code of ethics derived from the Hebrew and Christian heritage, and compatible with almost any religion.

The shift of emphasis away from the individual and toward the national state was, of course, accompanied by a continued reaffirmation of the concepts of law and morality by those nation states whose roots were in these principles. Thus the leading trading nations of the western world reflect in their trade policies, albeit imperfectly at times, the concepts of right and wrong, of fair play, and of mutual respect, which are common to us in Western Europe and the Western hemisphere. The process of European economic expansion into Asia and Africa during the 19th century carried these concepts with it, and we now find them quite firmly implanted, for example, in Japan, the Philippines, Indonesia and India. To say the foregoing is not to suggest that all nations in the free world live perfectly by the Golden Rule; this is far from the case. What is suggested is that there is common acceptance of certain standards of conduct, and that there is agreement on the meaning of right and wrong. Unfortunately, this cannot be said to be the case for the governments of certain other countries in the world—those of the Soviet bloc. Communists are professed atheists, and do not subscribe to what they term "bourgeois morality." They are presumably emancipated from conformity with moral standards accepted elsewhere in the world. This fact makes international cooperative living with these countries somewhat difficult. It also complicates the problems of international organizations which include countries dominated by Communist imperialism. This fact of a lack of common standards is at the root of most of our current problems, both political and economic.

During World War II, people in many countries gave thought to building the right kind of foundation for a world order free of major economic dislocation. One of the first results of wartime planning for our present world was the establishment of the International Monetary Fund and the International Bank for Reconstruction and Development. These two institutions, established by the Bretton Woods Agreement, have proved extraordinarily durable and helpful in promoting financial stability, a good measure of convertibility, and a great deal of sound economic develop-

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ment. They are specific organizations designed for certain definitive purposes, and they perform their functions very well—primarily because the governments which participate in them see their value and give them effective support.

This concept of the postwar world included an organization for international trade, and countless hours were spent by talented experts in seeking to draft a charter for an international trade organization. This charter fell upon hard times. International trade is highly complex, and the effort to develop good and meaningful ground rules did not seem to be what most governments—and legislatures—considered important in the world of the late forties.

On the other hand the Food and Agricultural Organization (FAO) of the United Nations took rather deep root in many countries of the world, and the subsequent years have seen it flourish. The FAO has diligently surveyed its field of activity year by year and its secretariat has assiduously addressed itself to a great variety of topics and problems in agriculture. The FAO sponsors study groups, and reviews at its council and conferences all sorts of problems of adjustment between the agricultural establishments of all types of countries. It has served effectively as a forum where officials from many countries have been able to agree upon facts and to adjust the operations of their policies.

The most important comprehensive agreement covering international economic relations is the General Agreement on Tariffs and Trade (GATT). There are essentially two parts to this agreement. One is the schedule of tariff concessions made by the contracting parties to each other, as supplemented or modified from time to time.

The other part of GATT consists of general trade rules, drawn with the idea of providing a code of conduct for governments in handling restrictions on trade. Essentially one of the purposes is to avoid the negation of tariff concessions by means of actions in the non-tariff field. There are provisions designed to limit the circumstances in which countries may apply quantitative restrictions to trade, provisions covering national treatment, subsidies, customs valuation, freedom of transit, dumping and anti-dumping duties, marks of origin, territorial application of concessions, nullification and impairment, state trading, economic development, national security, customs unions, free trade areas, and the like.

Specifically GATT has a great deal to say about agriculture. This is, of course, inevitable if one takes into account the extent to which governments intervene in agriculture, which tends to bring them into conflict with the principles of GATT. A most excellent discussion of GATT and agriculture is available in the form of an article called "Synthesis of Trade and Agricultural Policy in GATT" by Robert B. Schwenger, appearing in *The Journal of Farm Economics*, May, 1958.

We must remember that the GATT is not the International Trade Organization (ITO). GATT is a contract between certain countries, and meetings of representatives of these countries occur from time to time with the object of joint scrutiny over the effectiveness with which the provisions of GATT are carried out. These meetings have a sound moral effect on governments, which must explain to others what they are doing and why. Frequently there is criticism of GATT because it is imperfect, and because its commitments are in certain respects qualified. One hears derogatory comments about escape clauses, loopholes, waivers and time consuming procedures. No country is perfect in the equity, fairness, and operation of its policies, laws and regulations; and one can scarcely expect a contract on a vital matter among imperfect entities to be perfect itself. The negotiations at GATT meetings, furthermore, are between sovereign countries, and there is no such thing as a court which can enforce a judgment on a guilty defendant. The only enforcing agent is the moral

judgment of the collective GATT community.

One of the charges frequently made against GATT is that it represents an essentially negative approach to international trade, because it consists of a list of things countries agree not to do, except in certain circumstances. Also, tariff concessions are said to be modifications of conditions in trade, not positive actions to promote or direct trade. Some of the less developed countries, keenly aware of the benefits which they could derive from an improvement in their terms of trade, have sought to promote international commodity arrangements, and have complained that GATT is prejudiced against them. It is certainly true that the original motivating forces of the GATT and the ITO tended to dislike commodity stabilization schemes because they introduced unnecessary rigidities into international trade. Thus the ITO draft charter said in effect that commodity agreements should be undertaken very rarely, and only under specified circumstances when certain conditions had been carefully determined to prevail. Then, if enough of the governments with primary interest chose to agree, there could be a commodity agreement of specified form and under certain conditions. In other words there was recognition of the fact that there would be demand for commodity stabilization, but there was at attempt to prevent international commodity stabilization from assuming a rigid or excessively durable form. Certain resolutions which embodied these thoughts were passed by the United Nations Economic and Social Council in the early postwar years, to provide guidance to countries pending the development of an ITO which presumably would be designed to keep commodity agreements from getting out of hand The passage of these resolutions in the Economic and Social Council led to the establishment of a body known as The Interim Coordinating Com-

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mittee for International Commodity Arrangements (ICCICA), a committee of individuals, selected internationally, whose function would be to watch the commodity situation, insure compliance with the resolutions, and call to the attention of the Secretary General of the United Nations any circumstances which might require action or attention.

ICCICA, in principle, was supposed to give certain guidance to individual commodity study groups established in the early postwar period. These groups included the sugar council, the international cotton advisory committee, and the tin, rubber, and wool study groups.

The first commodity agreement to be negotiated after the war was the International Wheat Agreement, which has been twice renewed and is about to be reconsidered again. This agreement, while it has been useful as a means of bringing together countries interested in wheat, can hardly be said to have solved the problem of adjusting production to demand. It is probably safe to conclude, however, that without the Wheat Agreement the situation would have been worse. There was a Sugar Agreement before the war, and it was not until 1953 that it was renegotiated. Again, one may criticize the Sugar Agreement for not curing the imbalance between supply and demand; but it brings together the countries primarily important in sugar, and it gives them a place to adjust their differences, and to understand one another's problems. Sugar and wheat are particularly susceptible to international regulation. Both commodities are controlled on a national basis almost everywhere in the world.

The third commodity now subject to an agreement is tin. After considerable difficulty in getting under way, the agreement recently began to function as it was supposed to, but now its provisions are being defeated by action of the USSR in putting tin on the world market in large quantities. Efforts to interest the USSR in cooperation have so far produced only a statement of willingness to observe the operations of the agreement—no doubt, the better to defeat its objects. Tin is a commodity which has a few producers distributed among a number of countries, who have had the, shall we say, habit of cooperation in the past, and who find it easier to cooperate internationally than do some other industries.

In each of these three cases there has been a demonstrated need for international action to stabilize conditions for the commodity. In each case the negotiations of the agreement were complex, lengthy, and tiresome. All this proves is that in wheat, sugar, and tin, producers, consumers, and governments were willing to try a rather low common denominator of stabilization, which works after a fashion. It proves nothing for other commodities, and nothing for commodity stabilization in general.

The study group technique is of real interest. The basis for a decision to have a study group is usually a feeling that there is some sort of prob-

lem about a commodity, and the thought that a discussion of fact and opinion between countries might lead to some illumination as to whether action is needed or not. There are annual meetings of such groups as those for cotton and rubber, and they have been landmarks of effective cooperation on statistics and facts—with the help of a professional secretariat of unimpeachable neutrality—and of effective discussion, usually not in public, of problems affecting the commodities. Other study groups meet somewhat less regularly. A coffee group is in process of formation, based on a coffee committee of an inter-American organization.

During the raw material shortages which followed the outbreak of the Korean War, there were seven commodity committees covering sulphur, cotton, wool, copper-lead-zinc, pulp and paper, tungsten, molybdenum, manganese, nickel, and cobalt. Some of these recommended a sort of informal allocation system to combat the shortages, and some found after discussion that there was no real need for action. The complex was called the International Materials Conference. It is mentioned here as an example of an organization created to meet a specific emergency, which it did quite well, and designed to be scrapped when its job was done, which it was.

In other cases of maladjustment there may be less inclination to cooperate, because the problem has not been recognized so universally. Fundamentally, however, for difficult commodity situations the study group technique is the best. Government representatives and their industry advisers gather and review facts, analyze causes of imbalance, endeavor to apply good economic reasoning to problems, and determine whether or not there is a case for action. Of course there is ample opportunity for disagreement, and of course a failure to agree on urgently needed action could be disastrous. But sovereign governments have in fact no better way of cooperating in such matters; the study groups are professionally competent in the subject matter they handle. If governments or industry groups are in fact being unreasonable, this will be more apparent to others in the group than would be the case in a less technical and more political body. Again the effectiveness of the technique depends entirely upon the spirit with which member governments address themselves to the task. A narrowly national view will not promote solutions to problems, nor will it clarify the point that there is no need for artificial measures, if such is in fact the case. Study groups yield agreed facts, clarification of problems, and sometimes solutions. They should never be judged by whether or not they produce an agreement. They should be judged by whether or not member governments are internationally in conflict over the commodity as a major issue or not. Universal happiness over a commodity is not to be expected. Well-distributed moderate discontent is can c

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The United Nations itself of course has economic and trade discussions. These are mainly focused in the Economic and Social Council (ECOSOC). but occasionally they appear in the General Assembly. In part because of the presence of the USSR in ECOSOC, economic matters take on unnecessarily political tones. A recent example of unconscionable use of ECOSOC for political propaganda purposes was the obviously shallow appeal by the USSR for an International Trade Organization, after 13 years in which the USSR stood aloof while other countries labored to devise practical and meaningful international instruments for dealing with trade questions. The USSR, we must recognize, does not share the ethical values and principles of the Free World, but it knows the vocabulary, and now and then employs it to try to delude the Free World into thinking that the Soviet Union speaks the same language. The performance is not very convincing, however, because while the words may be the same, a translation of the intent is easily come by, and hardly anybody is fooled. But the chief point here is that the UN is often seized with trade and economic matters, and the actions of ECOSOC and the General Assembly and even the Security Council can have an effect on organizations designed to handle specific trade questions.

Regional organizations in some cases antedate the United Nations or the League of Nations, but they have come to full flower only in the past decade. Under the UN, there are regional commissions for Latin America, Europe, and Asia and the Far East. Africa and the Middle East seem thus far to have escaped this form of expression. There are of course many useful economic things for regional commissions to do. This is especially true in Europe, where the proximity and close relations of the economies of member countries require careful organization and effort to promote international economic welfare. Thus in the Economic Commission for Europe one finds a record of valuable and useful work in many fields, with ample opportunity for debate on all sorts of issues at the annual meetings, where the USSR is represented. The other two regional commissions have secretariats which have become centers for research and analysis of the problems of the areas, and some useful work has been done at annual meetings. The Organization for European Economic Cooperation is the most outstanding regional organization in terms of accomplishment with a minimum of debate. This is clearly due to the fact that member countries are anxious to make it work for its well-defined and agreed purposes.

In the Western hemisphere there is another sort of regional organization—the Organization of American States, with its semi-autonomous affiliate, the Inter-American Economic and Social Council. This, with its secretariat the Pan American Union, antedates the UN regional commission for Latin America, and provides a forum where all sorts of trade and commodity problems are discussed. Prominent on the agenda have been schemes for an Inter-American Bank, plans to assure countries against depreciation in the value of the U.S. dollar, programs for commodity agreements on metals, coffee, and bananas, concern over prices, restrictions, terms of trade,—in fact, every aspect of economic relations which one could imagine would excite people in one country or another. In all frankness it must be admitted that a primary function of the organization has come to be to furnish Latin Americans with a good forum in which they can, let us say, bring to the attention of the United States ways in which it could be more helpful to them in handling their economic problems.

The most striking example of a regional approach to economic problems is of course the European Common Market, or European Economic Community (EEC). This is a really dramatic decision by six countries to merge their economies. It was not easy for them to make the original decision; it has not been easy for them to continue to pursue the decision with all the detailed steps necessary to bring about this major adjustment. There have been times when delay and hindrance seemed inevitable, and when the cause seemed lost. Nevertheless they have persisted and are on their way to creating an economy which ought to be one of the most productive, efficient, and prosperous the world has seen. Their action has caused some consternation among other countries for a variety of reasons. Independent countries which produce tropical goods are disturbed because the overseas possessions of two of the six-Belgium and France-seem destined to profit immeasurably from the preferential position they will have in the EEC. Great Britain is disturbed over the challenge of European industry behind a common tariff barrier, and has sought through the Free Trade area project to bridge its European interests with those it has in the Commonwealth. This has disturbed some of its Commonwealth partners, in some degree because of the possibility that further protection to agriculture in Europe generally might ensue, and there seems to be a body of opinion in North America that thinks European agricultural protectionism has gone far enough.

Nevertheless, despite its imperfections, and despite the fact that some people do not like it for a variety of reasons, the move toward European economic integration will probably proceed. It should improve economic conditions for people in the six countries, and it will doubtless alter the pattern of trade a good deal. A really new operating principle is at work, and economies are in fact joining each other. Adjustments for other coun-

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tries are inevitable, and could of course be uncomfortable. There are other examples of such efforts. Chile and Argentina have claimed an economic union from time to time, and Central American republics also have their plans. The union of Egypt and Syria may have implications for Middle Eastern trade. Suggestions are made from time to time about economic union, or free trade areas, among countries not now affiliated with any such group.

At a time when multiplication in individual political sovereignties has really grown to tremendous proportions, it is perhaps reassuring to see a rather strong movement toward integration of economies. Without it, and without real cooperation among the leading trading nations, the world economy can be stifled by political nationalism of the kind which asserts that each nation must be self-sufficient in all major respects, no matter what the economic cost.

Sometimes our taxpayers ask why there are so many international organizations, whether they really serve a useful purpose, and what the chances are for some limitation on their growth, which proceeds in Parkinsonian fashion. Committee and commission are piled on each other, a list of international meetings looks like a commuter train schedule, countless officials bustle around getting up position papers and speeches on every conceivable subject, and delegates sit in sophisticated boredom, having already heard everybody say almost everything. Working parties report to committees, committees to commissions, commissions to councils, and councils to conferences in plenary session; documents and secretariat staff multiply and corridors are filled with people. This is, at least, the way it looks to many, and it is difficult not to sympathize, especially when one is challenged to show concrete, beneficial, and specific results.

Of course this critical attitude represents the view of those who like to think that international problems are things easily settled, if only the right people, or competent people, or the most responsible people, sit down and talk it over. This attitude is naive in the extreme; international affairs are often a contest of real interests not in the least disposed to yield to each other. Polite language and formal meetings frequently cover the most intense feelings and the most frantic scramble for position and influence. Diplomacy does not consist of victories won and scores settled, at least not good diplomacy. It is rather a process of continual adjustment of countries to each other, a recognition that vital interests do clash, and a search for a way to enable contesting parties to live in peace.

Membership in international organizations designed to promote cooperation in economic affairs is likely to lead countries to adjust their programs so as to minimize harm to others, and to collaborate for common ends. There is competition, of course, and it is healthy for it to continue.

This is the competition of seeing who can excel in what fields of endeavor, and of giving those who succeed the benefits of success. If a static view of the world market is taken, international cooperation will not succeed, unless a cartel is the object. An optimistic view of an expanding world market, and a recognition that there is room for all, given a set of rules by which all abide, is the foundation of cooperative endeavor in international economic affairs.

An international organization is no better than the governments which compose it, and it may be a good deal worse if the countries concerned do not care enough about the organization to make it work. Agreed standards for international living as between individual states, and the desire to cooperate, are essential. There are plenty of organizations, probably more than we need. We must concentrate our attention on the attitudes of governments, and of the peoples behind them. If the governments and the peoples recognize the Golden Rule, and are governed by ethical considerations, even though imperfectly, they will make the international economic organizations work, because they will want and need to. They will take a broad view of their international responsibilities, and they will express an enlightened self-interest in their economic policies. They may be slow or reluctant to admit their objectives, but they will do so if there are the moral roots. Thus what we are really discussing is not economics, or international organizations, but morality.

The rulers of the Soviet Union are committed to a dogma which admits no God and which eschews the idea of any absolute standard of morality. These leaders, and their followers, must have some sort of standard of conduct as among themselves; now and then we get a glimpse of what a gruesome sort of standard it is, or perhaps, if we take a charitable view, of how great are the exceptions made to a normal standard of conduct. But when it comes to dealing with the outside world, these people are not allowed by their creed to maintain a moral or responsible attitude; they may act as if they do; they may even personally wish they could; but they are governed solely by what the rulers of the Soviet Union decide they should do. If this means to lie, cheat, or steal in their international relations, this is what they will do, regardless of what one might judge their personal characters to be.

The policy of international communism is to control the world. The tools for this purpose are of all varieties. Soviet attempts to control international organizations or to use them for their own purposes are well known. But we must also be on guard against Soviet attempts to disrupt and destroy international organizations which already are working well, or which promise to do so, and which strengthen the Free World. It would be in the Soviet interest to sow discord and to embroil other countries

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with each other. The Soviet Union is not at all above using all the best words in the moral dictionary to try to prove to others that it too is moral. It will sound this way if it thinks it can, as a result, weaken others, subvert a situation in its favor, or simply spread confusion and distrust. Careful analysis must be applied to each Soviet move and word; the Soviet Union does not act casually, nor do its representatives express informal and personal opinions. It is a well-organized machine which does what it does deliberately, to achieve its purposes as it sees them. And its main purpose is to dominate the world.

This is a barrier to effective work in international economic organizations. It can however be overcome. It must be overcome, for the world is in fact interdependent and becomes more so, and its organizations must reflect the fact if we are not to perish. Cooperation in the Free World is essential if the onslaught of Soviet political and economic moves is to be resisted. Thus we must continue with our obscure GATT arguments about abstruse points. This is the hard way, but the right one. The easy way is to give in, either to the naivete at home which says that international living is all too much trouble, or to the Soviet machine abroad which tells us that it has a simple answer to our problems. Our eye must be on unity in principle, to be achieved through diversity in action and form. The principles are known to all, and accepted by our world; making them work is hard, but essential. If we do not make them work, now and in the near future, we might not get a second chance.

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#### MULTIPLE PRICE SCHEMES AT HOME AND ABROAD

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H. R. WOLTMAN
University of California

X YORLD economic developments over the last three decades form a picture of continual spasmodic change and instability, to which appropriate adjustments by nations both individually and collectively have been exceedingly difficult and at times impossible. Maladjustments within and between national economies on one hand, and the growing demands of domestic welfare objectives on the other, have greatly extended the range of government measures affecting trade. Looking back it seems almost incredible that there was a time-say, 1870-1914-when rapid economic growth in many countries was consistent with relatively effortless equilibrium of world trade and payments under a universal gold standard. That delicate balance had already been destroyed in the 1920's by differential changes in productivity and population, and the resulting deep-seated strains have been greatly aggravated by world depression, world war and postwar disorganization, the East-West struggle, the large and capricious effects of accelerating technological advance, and economic nationalism in the awakening underdeveloped countries. In some countries the desire for economic development has led to over-ambitious attempts to speed up structural change; in others, needed structural changes have been unduly retarded out of an over-tender regard for existing customs and vested interests. Often there are conflicts between the requirements of internal growth or stability and those of external payments equilibrium. Domestic industries have been insulated in varying degree from external conditions while the burden of adjustment to internal disequilibrium is often shifted to other countries via the foreign trade sector. Considerable progress has been made toward trade liberalization and currency convertibility in the last decade but payments problems continue to trouble many countries and the paraphernalia of state control continue to dominate international trade to a greater degree than ever before in peacetime.

In this state of affairs, one country plays a uniquely important rolean undesirably important role, some might say. The United States is the leading nation in world trade but its dependence on trade is relatively small. It has no payments problems but it is in the position of being able, by actions of rather minor domestic import, greatly to increase or lessen the problems of other trading countries. The international trading order since World War II has been and still is to some extent the creature of American loans and gifts, although the confidence of other countries in its viability would be greatly increased if the dollar gap could be bridged more by trade and less by aid, as they often tell us. But American trade policy is wonderfully illogical. The world needs our goods and American producers are eager to accommodate this demand; yet we prefer to limit our exports and in fact to give part of them away rather than undertake the unilateral liberalization of import trade that is clearly called for. There is no good reason for this except an unwillingness to endure the internal adjustments that a significant change in import policies would entail. By adopting the perfectly respectable but hardly appropriate principle of quid pro quo in commercial policy, we can proclaim our adherence to liberal trade doctrines without much risk of major concessions on our part. We can rise to occasions, as during World War II and in the postwar relief and reconstruction period, but whether we can be relied upon over the long pull to meet our responsibilities as economic keystone of the free world has not yet been established.

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On this score there are in fact increasing grounds for apprehension. Even if the United States does not differ much from other nations in placing the interests of domestic producers foremost, it is obvious that it is equipped to go much farther in this direction than countries that are less wealthy and more dependent upon foreign trade. A number of episodes in the last year or two have been sharp reminders that identical standards in this respect are not applied to the actions of all countries. One of the main causes of concern is American agricultural export dumping under a veritable battery of legislative authorizations. The contradictions between American agricultural policies and the stated objectives of our trade policy are well known, but until recently these contradictions arose mainly on the import side. The adoption of multiple pricing, however, carries agricultural protectionism outside our own borders where it is more likely to be viewed as a calculated and gratuitous piece of economic aggression, with the consequent possibility of complex economic and political repercussions. If the stated objectives of United States foreign economic policy are accepted as valid and important, then the export dumping practices which have come into use must be regarded as dangerous anomalies which raise broad issues of national and international significance.

In the United States multiple price plans for agricultural export products have appeared mainly in the form of (1) schematic proposals such as the McNary-Haugen and export debenture plans of the 1920's or the domestic allotment plan of the early 1930's, variants of which have reappeared recently in the Agricultural act of 1956, in the abortive House agricultural bill of this spring, and in a number of proposed certificate plans; and (2) nonsystematic arrangements for surplus disposal, including Section 32 export operations and provisions for aggressive dumping of

Commodity Credit Corporation (CCC) stocks under Public Law 480, the Mutual Security Act, and the 1956 Agricultural Act. I shall refer to the more or less automatic devices under (1) above as multiple price schemes, and to the activities included under (2) as multiple price practices.

Formal multiple price schemes have never found a place in American farm legislation, although they have had important indirect influences. The proposals of the 1920's provided a rallying point for agricultural discontent and helped open the way for the policy experiments of the 1930's. And the domestic parity concept which they embodied has been an increasingly dominant part of agricultural price policy since 1933. Advocation of multiple price plans for individual commodities, however. was dormant for two decades until 1953; since then there has been a considerable revival of interest centering mainly on rice, wheat, and cotton. This revival of interest coincides, of course, with the rapid growth of CCC stocks, which has already led to the employment of multiple price practices by the United States on an unprecedented scale. Although the multiple pricing issue in this country originated in the desire to raise agricultural prices, it is now associated with the consequences of (among other things) agricultural prices that have been kept too high for too long.

There is nothing novel about these consequences. They have tended to appear whenever any nation has attempted to valorize an internationally traded commodity, and the dilemmas they pose have confronted the United States on a number of occasions since 1929. Often before, however, the necessity of dealing with the problems of relative overproduction, declining exports and growing surplus stocks has been avoided or delayed through exogenous circumstances such as weather or war and, to some extent, through acreage restrictions-although the latter device has been decreasingly effective. The wheat and cotton stocks accumulated by the Farm Board in 1929-1932, for example, could be worked off in 1933-1936 because wheat production was kept below domestic requirements by a run of extremely bad weather and because drastic adjustments of acreage were effective in controlling cotton production. But new surpluses of wheat and cotton emerged after 1937, despite sharp acreage cutbacks of both crops beginning in 1938 and 1939. The accumulation of wheat stocks which took place in 1938-1942 was ended only by the heavy use of wheat for stockfeed and industrial alcohol that wartime conditions made possible in 1942-1945; and the elimination of the 10 million bale cotton carryovers of 1938-1945 depended mainly on the accident of poor crops in 1945 and 1946. All-out wheat production to meet desperate world needs was encouraged in 1944-1948 by high prices and the removal of acreage restrictions, but new surplus problems ensued in 1949-50 with the ending of acute food shortages and the recovery of

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European production. Rising cotton acreage and increased yields in 1947-1949, in the face of declining domestic consumption, resulted in rising cotton carryovers also. This time the growth of surpluses was interrupted by the sharp increases of domestic and foreign demand initiated by the Korean war and, in the case of cotton, by the unfortunate conjuncture of sharply restrictive acreage allotments and low yields in 1950—just before the buying spree of 1950-51.

But no new catastrophe has come along to dissipate or turn into an advantage the tremendous surplus problems which have developed since 1952. Drastic cutbacks in wheat and cotton acreage beginning in 1954 have been offset or more than offset by rising yields and, despite the export "achievements" to which Secretary Benson has seen fit to point with "pardonable pride," we are still dealing with billion bushel wheat carryovers while the cotton industry has been slowly throttled to keep it from responding to inappropriate price incentives.

More is involved in the present difficulties than a perverse price policy, to be sure. A good deal of the high price history which has been capitalized in the cost and production structure of agriculture and in farmers' expectations was either a necessary part of the war effort or merely reflected the state of postwar demand without benefit of price supports. Much has been given to American agriculture but much has been demanded of it, and something must be conceded to the view that equity as well as political reality required a considerable cushioning of the price effects of a return to more "normal" demand conditions. Nevertheless, the need for a change in policy now appears to be widely recognized. Unfortunately, however, recognition and response are not the same thing. Those who insist on flexible (lower) price supports with real "flex" in them have made slow progress so far and it seems highly doubtful that sufficiently low prices to eliminate existing disequilibria can be obtained by this method in the near future. Also, acreage allotments on cotton have reached what is very likely a politically irreducible minimum and wheat may not be far behind; but the advancing trends of productivity and yield per acre appear to continue. Even a truly flexible price support program might, therefore, be accompanied by surplus disposal problems for some time to come.

Therein lies the appeal of some of the recent proposals for multiple price schemes. Export subventions have been with us on an occasional basis since 1930, but their use has grown alarmingly in the last three or four years as a result of determined efforts to get rid of an expensive and embarrassing accumulation of surpluses. Such efforts have themselves been costly, embarrassing and highly visible, however, and they are directed (we are told) toward a one-time disposal of excess stocks, although there are reasonable grounds for skepticism in the latter regard.

Multiple price schemes, on the other hand, can be made wholly or partially self-liquidating; they involve a form of export dumping which is a little less obvious and clear cut; and, without eliminating surplus production, they can dispose of it as it arises on a permanent basis.

Conceivably, returns to producers under a multiple price scheme could be set so low as to produce definite disincentives to production (presumably with income supplements not tied to commodities), just as they could if price supports under the present system were made entirely discretionary. But if that were contemplated, what point would there be in the multiple price approach? Actually, however, it appears incentives to producers under currently proposed plans would not be much different from what they are now. The fixed value certificate plan for wheat would return 100 per cent of parity on wheat destined for domestic consumption-say about 475 million bushels a year. On the remainder, either a free market price would prevail or a price support would be established at a corn-equivalent level in order to avoid damage to feed producing interests. The latter arrangement seems most likely and is in fact the form taken by the scheme contained in the recent House bill. Assuming a secondary price support for wheat as low as 50 per cent of parity (about \$1.21 in June, 1958), the average price received by farmers would vary from about 80 per cent of parity for an 800 million bushel crop to about 68 per cent of parity for a 1.3 billion bushel crop like this year's. For the harvest that might have been produced on this year's acreage with more normal yields-roughly 900-1,000 million bushels-the return would average about 74-76 per cent of parity, or just about the same as this year's support level.

The three-year scheme for cotton included in the House bill would have given individual growers a choice between the present program (price supports at 81 per cent of parity on this year's acreage allotment with an expected slight increase in 1959) and a one-third increase in acreage allotment at price supports as low as 60 per cent of parity. CCC sales for unrestricted use would be required at 10 per cent above the lower support level, or about 66 per cent of parity. By this means, cotton prices for both domestic use and export could be cut approximately to or below recent world levels, enabling cotton to compete more effectively with other fibers in domestic markets and domestic cotton textile manufacturers to compete better with foreign producers, while raw cotton could move directly into export channels without additional government intervention-although special export programs would presumably continue to be available. The effect and the intent, I take it, would be a considerable increase of production and a corresponding increase of exports. Efficient producers would expand plantings; less efficient pro-

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ducers would continue to be protected by relatively high price supports.

And so it goes. Present multiple price practices and the proposed plans

differ in form rather than in content; both are concerned less with correction of the disequilibrium that has arisen from parity-based price support policies than with exporting the evidence that it exists. Measures now in use tend to placate domestic criticism of unsalable accumulations of stocks, while the permanent schemes would remove much of the criticism based on costs to taxpayers. This is done, however, only by placing narrow producer interests in the United States in direct conflict with the national interests of other exporting countries where agricultural trade is

often a basic necessity rather than a mere vent for surplus.

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Here is the real issue raised by American multiple pricing policies, and it is not adequately addressed by the various arguments advanced by way of justification or apology, most of which proceed from the questionable premise that maintenance of agricultural export trade is inherently desirable in view of the traditional importance of export markets for certain commodities. Wide and mainly unconditional acceptance of the proposition that export markets ought to be kept or recaptured leads to rather legalistic rationalizations of export dumping as a going concern. We make claims upon a "fair" share of trade which other countries can oppose with similar claims resting on different base periods. We counter charges of unfair export practices with our own allegations of unfair practices abroad. To other exporters who express concern over having international prices and export volumes which are vitally important to their national welfare dependent, in effect, upon unilateral decisions by the United States, there is the reply that the United States has considerably reduced acreages of commodities in surplus while production and exports abroad have been protected and expanded under a price umbrella held by the United States, and that there is no obligation to continue extending these benefits to other countries.

These are arguments which seek to justify, to explain, even to reassure —but they do not get at the underlying problem of imbalance and how it is to be corrected. Because the United States quite clearly is uncertain of its own intentions in the regard, other countries are left completely uncertain as to what kind of long run behavior may reasonably be expected from the most important single influence on world markets for a number of commodities; and they rightly resent it when export dumping programs advertised as temporary give every sign of being prolonged indefinitely due to a standoff in the American game of agricultural legislation. This resentment is properly a matter of great concern to the United States, not only in terms of possibilities of retaliation and trade warfare, but also because of the indirect risk of ill will and impaired international coopera-

tion on a much broader front. What needs to be stressed is that this risk is being incurred for the sake of a dubious domestic agricultural program into which we have drifted as the result of a series of short-run expedients.

The external interests at stake are not hard to identify. Those commodities on which special export inducements are most heavily concentrated by the United States—wheat and cotton—are items for which international demand shows little sign of expanding. American surpluses which are pressed on world markets therefore tend to replace exports from other countries pretty much on a volume-for-volume basis and, while such activities have been somewhat restrained by the desire to avoid extreme dislocations of prices and trade patterns, important adverse effects on the international payments positions of individual countries have been inescapable. By and large, the affected exporting countries are much more dependent on trade than the United States and their over-all capacities to import tend to be more closely related to export earnings of particular commodities. As a group, they are direct and unequivocal losers.

These observations apply with special force to exporters of cotton, world production and consumption of which has increased by about one third in the last two decades while international trade is virtually unchanged. Competition from rayon and other manmade fibers in the more advanced nations and increasing regional self-sufficiency in cotton manufacturing based on local supplies in the less developed areas are likely to continue to prevent any considerable increase of trade in raw cotton in the near future. Nevertheless, a substantial growth of cotton export from countries other than the United States began in the 1930's and resumed after World War II, reaching a peak of nearly 11 million bales in 1955-56, of which about 9.3 million bales was from noncommunist areas. Much of this development was accounted for by countries which until recently had been insignificant in world cotton trade. When special export programs permitted the recovery of American cotton exports from 2.2 million bales in 1955-56 to 7.6 million and 5.7 million bales, respectively, in the last two years, exports from other countries of the free world were reduced to 6.7-6.8 million bales. American stocks now have been markedly lowered and, with a new low in harvested cotton acreage in 1958, an additional decrease in carryover is indicated for 1959; in fact, concern is expressed in some quarters over the possibility that supplies of better-grade cotton which are most in demand will be inadequate. There is every likelihood that United States production will be allowed to in crease for this reason and in order to maintain an export volume of around 5.5 million bales, which appears to be a magic number in Washington Since no basis exists for assuming an improvement of import demand, continued exports of 6 or 7 million bales from other free world produces is implied.

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But much depends on how far other countries are prepared to go in challenging United States export plans and how far the United States is prepared to go in defending them. The considerable reduction of world cotton prices since 1955-56 has interrupted but not reversed the rising trend of acreage and production abroad. It cannot be assumed that the rise of the newer cotton exporting countries is merely a transitory development unlikely to survive trade conditions loss favorable than those during much of the last decade. Cotton is generally the most profitable crop by a considerable margin in the areas where it is grown, and in many of the new areas the shift to cotton cultivation must be regarded as permanent, for it is associated with long-term agricultural development programs which release resources from food production and make them available for other cash crops. A number of exporting countries, moreover, have insulated domestic cotton prices from world prices by means of export taxes, reductions in which can buffer the impact of lower external prices. Others may find it expedient to resort to multiple pricing themselves in an attempt to protect what has become a major source of badly needed foreign exchange. However, it is uncertain how far or how long most governments could afford to go with cotton export subsidization in competition with the United States, since the probable outcome would be reductions in price far outbalancing any possible increase of exports. On the other hand, American exports are not likely to be pressed without regard to price levels either. Thus there is a temporary stalemate, but the situation is clearly unstable.

Leaving aside the question of changes in price levels, the real bone of contention, so to speak, is whether something like three or four million bales of cotton, at most, to a value of perhaps a half billion dollars a year, shall be exported by the United States or by other suppliers, mainly Latin America, African ex-Egypt, and the Middle East. The relationship between export trade and economic development in these areas and the long-term interest of the United States in their development problems is obvious.

Much the same kind of unwilling and unstable accommodation to United States export dumping has taken place in the case of wheat. Here Canada has borne most of the burden, apparently preferring to limit its exports and accumulate stocks rather than accept the lower total revenues that would result from all-out price competition with the United States in the face of inelastic demand. Meanwhile, Argentina and Australia have played a passive role. During 1955-56 and 1956-57, part of the United States wheat surplus was, in effect, transferred to Canada, but total year-end stocks of both countries actually increased. A reduced 1957 crop and increased exports in 1957-58 have improved Canada's surplus position somewhat, but the record American crop of 1958 will raise total North

American supplies higher than ever, and the dilemma of lower exports versus lower prices will continue to confront Canada. United States export dumping of wheat may not have the same balance of payments and economic development implications that we noted with respect to cotton, but nowhere are the uncertainties and naked conflicts of interest stemming from American policies more evident than in the United States. Canadian wheat relationship.

The issue between the United States and its export competitiors is also a basic domestic issue, which can be indicated with greatest generality by considering the possible consequences of a reversal of the course now being followed. What competing exporters and domestic critics of the present policies presumably would like-and the most that could legitimately be asked in the way of unilateral action by the United States in any case—would be a complete removal of direct and indirect agricultural export subsidies. Assume, as an extreme case, the elimination of all price supports and production controls as an alternative to existing programs. Important segments of American agriculture have been sheltered from world market developments for so long that one is quite at a loss to know how they might perform should they be put back in touch with international price levels. Other exporting nations may suppose, and many Americans quite evidently fear, that American agriculture could not compete strongly in world markets and that a considerable contraction in certain lines of production would be necessary. Should such opinions be borne out, some very painful readjustments would be in store. This possibility, even were it a dead certainty, detracts nothing from the position taken against American export dumping by its critics. Indeed, it adds force to their contentions, for the extent to which a rearrangement of agricultural production and trade might take place would indicate the degree to which present export arrangements are violating real patterns of comparative advantage-if, in fact, they are doing so.

One might also expect internal resistance to such a policy change, however, according to the magnitude of the adjustment problem expected; there would appear to be a perverse logic in the present situation by which the difficulty of bringing about a reform in American policy tends to increase directly with the economic validity and need for the reform. But the internal difficulties should not be too much emphasized. What is involved for the United States even in the most extreme conceivable case would be (1) a partial or entire disappearance of export outlets for one or more important commodities and (2) a reorientation of government policy to assist an accelerated movement of human resources out of agriculture, probably with indemnification of those who are badly damaged. From the standpoint of the over-all trade and payments position of the United States, the loss of export markets for noncompeti-

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tive commodities would have little significance since regular commercial exports are limited only by the total availability of dollars abroad and this would be unaffected. The implied structural changes in American agriculture are indicated as desirable in any event and to speed them up, under the extreme conditions assumed, would ultimately result in a net gain of economic efficiency in a welfare sense. It is an American paradox that high and growing productive efficiency leads to wealth that makes possible the luxuries of waste and inefficiency. By the same token, however, the economic strength that permits inefficient resource allocation also presents a wide range of long-run alternatives. We can afford to be efficient and, depending on cold war developments and the enthusiasm with which we commit ourselves to economic development abroad, it might even become important to do so.

Whatever its attractiveness as a long-term proposition, a reintegration of American agriculture into the world economy is not likely to happen quickly or in the near future. Presumably, a lengthy transition period would be involved even if no unnecessary delays were introduced by the temporizing tactics which have become so familiar. Yet it is urgent to come to terms rather quickly with the countries that are, as it were, victim of our indecision. This probably means a negotiated interim agreement or understanding.

A compromise of claims and counterclaims is probably not a workable basis for such an understanding. Bearing in mind that the longer term goal is, or ought to be, a return to resource allocation through market prices rather than through the crude instruments of government policy, an attempt might instead be made to agree objectively on what such an allocation of resources might look like. With this as a benchmark, it might be possible approximately to construct the corresponding American commodity export patterns while still maintaining internal controls on agriculture. Where current or politically planned export volumes differed markedly from the estimated "as if" levels, a time schedule for adjusting them could be arranged. By loosely scheduling its average cotton and wheat exports in advance on a unilateral but agreed basis, the United States could accomplish two important purposes. It would remove a great deal of the uncertainty now inflicted on competing exporters, and it would be given both the unavoidable responsibility and the time to work out whatever production adjustments were determined to be properly its own. (It is, of course, entirely conceivable that current American exports of wheat or cotton might turn out to be no larger than the estimated competitive volume, in which case at least the international air would be cleared somewhat.)

No doubt there are many reasonable objections to a scheme of this kind above and beyond the obvious political obstacles within the United States.

It is mentioned here not as a specific proposal but merely as suggestive of the kinds of alternatives toward which we ought to be groping. There are two probable objections to consider, however, because they also enter importantly into the justification of present American multiple pricing practices. One has to do with multiple pricing by other countries, and the other

with surplus disposal as a means of extending foreign aid.

It is easy to exaggerate the prevalence and importance of multiple pricing abroad. Most nations have agricultural price supports of one kind or another, and many have multiple exchange rates. Quite frequently it happens that support prices exceed the local currency equivalent of export prices or that a particularly high exchange rate is applied to a major export commodity, thus giving every appearance of export dumping. More often than not, this appearance results from the typical postwar phenomenon of domestic inflation combined with greatly overvalued exchange rates, and the dumping is nominal rather than real. Where the dollar-equivalent local price of an export commodity is greatly out of line with international prices, the official exchange rate is immediately suspect. If, on the other hand, exchange overvaluation is not a factor and the dumping is real, one often finds either that the country involved is a small or marginal exporter or that the domestic-export price differential is so small and at such a low price level as to raise the question whether it is not in the nature of a "legitimate" price stabilization operation. Without going into the difficulties of distinguishing between price stabilization and price support, it may be observed that most nations are just not able to afford continuous large-scale dumping of major export commodities in the style of the United States. When dumping is an important factor, however, negotiation along the lines indicated should deal with it more effectively than existing policies.

One of the claims made for concessional export sales by the United States is that they have contributed to economic development abroad by providing needed but otherwise unobtainable goods to poorer importing countries through long-term loans in their own currencies. Even persons and organizations critical on other grounds are inclined to commend this aspect of the American export programs. It seems to me that the general relation of United States export dumping to foreign aid objectives is not much closer than the relation between the agricultural policies of the 1930's and the conservation objectives they espoused. Given an existing surplus stock, no one would deny that it is better used for a worthy non-commercial purpose than allowed to rot. But it is quite a different matter when that worthy purpose is made a basis for perpetuation of the conditions that gave rise to the surplus or for dumping in regular commercial markets. In making the best of a bad thing we may be lead to overlook that it really is bad. In the absence of a multiple pricing-surplus disposal

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situation, it is hardly likely that the United States would extend aid in this form. Were we so inclined, however, we could do so quite simply by purchasing the goods on the open market at home or abroad and making them available on the same terms as at present. That we would not do so indicates both that this kind of aid is inefficient and that it does not lend any particular justification to the agricultural policy context in which it appears.

# DISCUSSION: TRADING PROBLEMS IN INTERNATIONAL MARKETS

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It seems obvious from the assigned title of those papers that in the "real" world of today there is little opportunity for free competition to exert its influence in international markets. Time was when a student of economics could tuck the nth edition of Alfred Marshall's *Principles of Economics* under his arm, head into the masses of pertinent data with established models, and fairly accurately forecast consequences induced by the variants in the system. Now there is less economic competition (Hudson-Gherson), more institutions (Armstrong), and more schemes or practices (Woltman) governing international trade.

In the process of evolution, international trade has become institutionalized and noneconomic factors have become relatively more important in evaluating the consequences of changes in the relevant variants. In fact, even the important causal variants have changed and many of them must now be classed as noneconomic. It is this dramatic change in the structure of the international trading system that has led to the creation of new problems and, at the same time, more and different concerns.

The Hudson-Gherson and Woltman papers contain several positive conclusions which with our present state of knowledge might well have remained as hypotheses. One statement from each paper may serve to illustrate this point. Hudson-Gherson conclude that barter sales have had an adverse effect on the normal trade of other exporters; Woltman states that Canada has borne the brunt of our export dumping. The first statement is true only under certain specified conditions (not stated); the second might well have thought of the consequences of alternative U.S. policies which would have prevented surpluses. On the Armstrong paper one point will be underscored and elaborated upon later. The trends toward nationalism will continue and the policy of the Soviet Union will continue to confuse and confound the western world.

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Now to some concerns on present day trading problems.

1. In spite of the post-World War II attempts to develop an international point of view among the nations of the world, there is an everincreasing tempo within nations to become more self-sufficient. When basic conflicts between national and international policies emerge, they tend to be resolved in favor of the former. FAO has made some rather intensive and revealing studies on the effects of national agricultural policies on trade that are worth noting. Most of the underdeveloped nations of the world have policies aimed at keeping food prices low in order to encourage greater consumption. The developed countries attempt to keep farm (and, as a consequence, food) prices high so as to yield incomes to farmers comparable to nonfarmers. To an extent these national interests are compatible with the broader international interests. Permanent dumping may generate fewer evils than temporary dumping, but it certainly puts the brakes on the drive for self-sufficiency in the underdeveloped countries. Our Public Law 480 program, though its underlying principles are basically good, cannot be given a straight "A" in all countries, to say nothing of the international effects of our national policies which led to its enactment. In short, greater self-sufficiency in underdeveloped countries likely is consistent with an international point of view, whereas in developed countries it is more likely to be inconsistent. Most countries fall into the former class, while most of the trading problems are generated by those in the latter.

2. A second concern grows out of the first and can only be posed as a question because no answer exists. Can the free nations of the world afford to maintain an international point of view in its trade policies? Ponder the recent developments in the Middle East as well as other demonstrations generated by anti-western feelings, then observe the operations of Iron Curtain countries and reflect on the outcomes of various strategies. It makes an interesting game theory model—one which our own State Department has reasoned through many times. But is it an economic model? There are economic consequences to be sure, but it is far from a pure economic model.

3. A third concern deals with the instability of stated goals and the economic conflicts that exist among them. Take the United States as an example. Is it possible to (a) help domestic agricultural producers with price supports, soil banks, protective tariffs, and other programs; (b) help the total economy with policies designed to raise levels of living; (c) improve the lot of all other nations with whom we trade; (d) dispose of our agricultural surpluses; (e) maintain a favorable balance of trade; (f) stabilize prices, etc., etc., and, at the same time, argue that it consitiutes a consistent set of economic policies fulfilling accepted welfare criteria? No, and to insert a value judgment—nor should it be. But the tense, ever-

changing world situation makes it difficult to establish long-range economic goals and programs consistent with them. We operate programs in the short-run as a practical matter, but the fear is as Kenneth Boulding once rather facetiously stated, that the addition of the short-run doesn't add to the long-run, rather it leads to utter destruction.

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4. A final concern is that in the profession of agricultural economics too much attention is paid to the trading problems in international markets and too little attention to their solution. No other important area in agricultural economics is so lacking in research and education programs—intensive study—than this. Colleges and universities are doing little, governments cannot do much, the Food and Agriculture Organization and other organizations of the UN with interests have limited budgets. The problems are acute and likely chronic; likewise are their needs for solution.

In brief, trading problems in international markets have arisen primarily from national and international trade policies and programs. Noneconomic factors have become more important in establishing these polices and programs through time as have their economic consequences. More attention from our profession needs to be directed towards the solutions of these problems.

## DISCUSSION: TRADING PROBLEMS IN INTERNATIONAL MARKETS

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Hudson and Gherson show how and why international trade is so different now from what it was before World War I. They then put the problem of international trade in farm products in a nutshell. "The real problem which the present state of international trade poses is how to impart elements of resilience, flexibility and adjustment which appertain to the free market system without prejudicing those measures of stability introduced by governments which it would be desirable to retain."

Reference is made to three international governmental organizations which have made important strides in coming to grips with this problem. They are: GATT, OEEC, and FAO.

He suggests a measured return or approach towards multilateral complementary relationships in world agricultural trade based on some acceptable criteria of comparative advantage, and to be consummated by effective intergovernmental consultations through the three organizations named above.

Armstrong agrees. He tells us that international institutions affecting

trade are necessary. The purpose of these international institutions is to provide means for agreed international action, or to establish a multi-lateral forum organization for resolving conflicts. He lists several other agencies of this sort in addition to the three referred to by Hudson, but points out that they can be no better, and can go no further, than the policies of the governments which belong to them. International organizations cannot in and of themselves resolve problems; they can only be a helpful medium through which the governments can try to work out solutions.

Woltman's paper is concerned chiefly with the effects of Public Law 480. This unilateral action by the United States does not fit at all into the recommendations of the other two speakers. Mr. Woltman does a good job of pointing out the effects of United States actions under P.L. 480, and shows that operations under this law are likely to perpetuate the conditions that lead to the continued creation of surpluses. He ponders how we might get American agriculture reintegrated into the world economy, and hopes for a return to resource allocation through market prices rather than through the crude instruments of government policy.

He suggests as an interim measure that the United States loosely schedule its average cotton and wheat exports on an unilateral but agreed basis for several years ahead. This means a rough sort of budgeting procedure, which would reduce the uncertainty now imposed upon competing exporters, and show the United States more clearly what production

adjustments need to be made.

The United States should go further. As Marion Clawson says, there is almost complete agreement among agricultural economists that dumping of our surpluses abroad will not solve our surplus problem in the future, any more than it has in the past, and that in general it is very bad national policy. John Davis yesterday estimated that the United States would produce \$10 to \$12 billion of agricultural surpluses over the next five years, and that most of this would need to be disposed of under P.L. 480. This is a sobering prospect. Can we not make better progress than this toward integrating American agriculture into the world economy?

We could, if we would distinguish more clearly between the two different jobs—(1) stabilizing the prices of farm products about the long-run market level, which can be done by storage and unstorage operations, and (2) supporting or increasing net incomes per farmer (which is several steps removed from supporting prices per unit of product) by trying to

raise the long-run level of prices through storage operations.

This distinction could be made more clear if the basis for loan rates for stabilization purposes were changed from percentages of parity prices to percentages of the moving average of open-market prices during the most

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for to ost recent few years, leaving the problem of farm income to be attacked by other more appropriate means. Something of this sort is proposed for corn in the most recent farm legislation in the United States. If this basis were used also for international commodities such as wheat and cotton, this would reduce the disturbing effects of P.L. 480, and take United States agriculture a good step in the direction of reintegration into the world economy.

An average market-price basis of this sort for wheat would reduce the present wide disparity between the world prices and domestic prices of wheat. This would reduce the present incentive for United States wheat producers to over-produce wheat, and reduce the size of the subsidy on wheat, thus reducing the load on the American taxpayer and improving the world distribution of wheat production more nearly in line with comparative advantage.

# MEETING CURRENT AND AREA DATA REQUIRE. MENTS IN A CHANGING AGRICULTURE

Chairman: Walter H. Ebling, University of Wisconsin

## PRESENT AND FUTURE PROGRAM FOR AGRICULTURAL STATISTICS IN CANADA

C. V. PARKER AND ALAN D. HOLMES Dominion Bureau of Statistics, Ottawa

THE Dominion Bureau of Statistics (DBS) has become the primary statistical agency for Canada, although collection of agricultural statistics is currently carried on by many Canadian agencies. The DBS was established in 1918 as a central statistical agency to provide statistics for Dominion government departments and the public at large. It was and is recognized, however, that government departments do collect statistical data as part of their administrative procedures, and the DBS is empowered to collaborate with all departments to avoid duplication and to promote efficiency in data collection. Provincial governments also have a large stake in agricultural statistics and over the years informal agreements have been reached between DBS and the provinces for cooperation and coordination in the collection and processing of data. As a central statistical agency, the DBS has a recognized responsibility for the development of an integrated national system of agricultural statistics.

While a comprehensive program of agicultural statistics has been developed for Canada over the past 40 years, much remains to be done in keeping up with the ever-growing, ever-changing demand for statistics about Canadian agriculture. A more comprehensive coverage of the economic and social aspects of agricultural activity at the national and provincial level is now wanted. At the same time, there is a persistent demand for more intensive coverage of Canada to provide statistics for areas within provinces, i.e., small-area data. Increased frequency, more detail, improved timeliness and greater accuracy are stressed for both the

so-called current data and the small area data statistics.

There has been appreciable progress in meeting these demands. However, the impact of developments in the technology of collecting and processing data has only begun to be felt in the field of agricultural statistics. A vastly improved range of sampling techniques is now available. Measurement errors in addition to sampling errors are now more widely recognized and methods of circumventing them are beginning to become available. Speedier, more complete and more complex processing and tabulation are now possible with electronic tabulators and computers.

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The use of the newer technology in supplying statistics is not without limitations. Samples which provide estimates of satisfactory reliability at the national or provincial level may not provide estimates of satisfactory reliability for small areas within provinces. Avoidance of respondent reporting errors through, for example, objective counts or measurements would be relatively costly. Electronic computers too are costly.

The older established methods will continue to play an important role in the collection of agricultural statistics in the foreseeable future; new methods will be introduced but these will likely support and supplement, rather than replace existing methods. In support of this view, the historical development of the present system of agricultural statistics in Canada is outlined, present collection methods and some alternatives are critically commented on, and finally possible future developments are suggested.

## Historical Development of the Present System

The present system of collection in Canada has been developed step by step with the changing demands for statistics. The demand, however, in recent years, has increased greatly; this demand includes volume in number of series, frequency, timeliness, accuracy and intensity of coverage area-wise, ranging from national to small area totals. These statistics have to be produced, of course, within limited budgets and within the competence of staffs available.

It is convenient to divide agricultural statistics in Canada into two classes: (1) statistics pertaining to the farm and (2) commercial statistics which relate primarily to off-farm processing and disposition of farm products. While these two types of statistics were developed simultaneously, there is a distinct difference in the problems associated with each and it is preferable here to treat them separately.

In the beginning the Census of Agriculture was the chief medium for collection of farm statistics. Traditionally, a decennial census covering all provinces in Canada has been taken. In addition, there has been a quinquennial census of agriculture covering the three prairie provinces. In 1956 for the first time, the quinquennial census was extended to cover all provinces. The scope of the censuses has changed greatly over the years in response to increasing demand for more detail for small areas and for improved knowledge about the structure of Canadian farming. The census has always and still provides a count of producing units, i.e., acreage in individual crops and numbers of kinds and classes of livestock and poultry. At one time, questions on production and utilization of products were included and later, as the need arose, information on expenditures, income and farm practices was collected. The census of 1941 was a culminating point in expansion of the scope of the census reaching a total of

over 1,000 questions. In the 1941 census, financial questions on farm business expenditures and income were all-embracing.

In 1951, however, a substantial cut to 450 questions was made and in 1956 only 85 questions were asked, primarily on numbers of acres in individual crops and numbers of livestock and poultry on farms at June I, the census reference date. The reduction in the scope of the farm census was accomplished by virtual elimination of questions on production, income and expenditures, for which reporting errors were believed excessive. The reduction in questions and the introduction of improved tabulation methods reduced cost and time of tabulation considerably.

Farm statistics for intercensal years have had a development in Canada similar to that in the United States. The voluntary mail survey has become the primary medium of collection. Mail surveys were started on a national basis as far back as 1908 when the annual June survey of crop acreages and livestock numbers was instituted. In 1931, a December survey of livestock numbers and disposition was introduced, with additional questions on farm wages. These semiannual surveys serve as the foundation of intercensal statistics pertaining to the farm. From them, are derived so-called sample indications of change in acreages and livestock numbers, and in conjunction with census benchmarks provide current estimates of producing units on farms. In the earlier years, questionnaires were distributed through the schools primarily and no follow-up of non-response was attempted. In more recent years, lists obtained from the farm census have been used for direct mailing and one mail follow-up of non-response was instituted in 1954, more than doubling the number of returns. The surveys are characterized by a large absolute number of farm returns but do not yield probability samples.

In addition to the semi-annual general farm surveys, regular monthly and quarterly surveys of particular groups of farm commodities have been developed. For these surveys, special corps of correspondents or reporters were acquired, supplemented and replaced over the years. The crop reporters list is the oldest of the four lists currently operating. Crop correspondents report eight times during the year on such questions as acreage intentions, crop yields per acre, farm stocks, grain fed and crop conditions. They report on an own-farm basis and on a neighborhood basis. Poultry correspondents report monthly on production, sales and farm use of poultry meat and eggs. Price correspondents report monthly on prices received by farmers and periodically on wage rates in their neighborhood. Dairy correspondents report monthly on utilization of milk

Reports from the regular correspondents are a mixture of eye observations or judgments and, in some cases, reporters' objective measurements. The reporter lists were never randomly selected but have always

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been geographically scattered and since 1946 there has been a concerted effort to adjust the size-of-farm representation in accord with the farm universe as recorded by the Census of Agriculture. All the regular correspondents' surveys are mail surveys.

In recent years, additional farm mail surveys have been instituted covering production of special crops such as vegetables, fruits and honey. Periodic turkey surveys were also introduced and a quarterly survey of hog producers was begun a few years ago. The surveys were an answer to a steadily growing demand for more reliable, more frequent, and more timely statistics. Lists for direct mailing of questionnaires are obtained from the Census of Agriculture, including lists of large producers. Some experimental follow-up of non-response on the vegetable, fruit and honey surveys was undertaken but resources were inadequate to secure significant results.

Since 1951, a very limited development of probability interview sample surveys of farms and farm families has been started. Prior to the 1951 census, a decision was made to strip the census questionnaire of much of the financial data, i.e., unit values, indebtedness, income and expenditure. Unit values for livestock in particular were obtainable from other sources and were applied to livestock inventories to obtain capital values of these items. It was proposed at that time that a sample survey of farms be undertaken to obtain financial and other data which were not only difficult to enumerate but also needed more urgently for large areas. Such a survey was undertaken in 1952 using the rural part of the labor force sample frame. The results were not satisfactory and plans for a special sample frame for agriculture were started, though some study had been given to the subject prior to that time. An area sample frame was constructed and a sample selected from it was used in 1956 for a quality check of the Census of Agriculture. This year, an interview survey of farms and farm families will be undertaken to collect the financial statistics for which a serious backlog of demand has developed. This experience of shifting from an established method to a new one without an overlap, pending satisfactory introduction of the new method points up a real problem. Adequate resources in trained personnel are needed for necessary research and planning.

The second class of agricultural statistics, i.e., commercial statistics relating to off-farm processing and disposition of farm products, is highly developed in Canada. In contrast to the farm universe, the commercial universe is characterized by a relatively few number of establishments. Also, commercial establishments have fairly good detailed records of their operations. For these reasons, census-type mail surveys have developed as an important medium of collection.

At the same time, an important group of statistics ensuing from ad-

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ministrative functions has been developed in Canada. For the most part these are confined to commodities and to "off" farm activities, such as deliveries to central marketing plants, gradings, prices, and inspected kill of animals. They also pertain to a "commercial marketing sphere" which excludes direct farm-to-consumer sales and sales to small local firms. The volume of such statistics has grown apace with the development of government programs to inspect and grade farm products, and in recent years. to support farm income by price and insurance type payments. The formulation of such programs as well as the continuous process of decisionmaking in implementing them has required increasing statistical services. Insofar as so-called commercial commodity statistics are concerned the nature of the administrative set-up provides a medium of collection. The Canadian Department of Agriculture and the Board of Grain Commissioners are two principal agencies providing detailed statistics as a byproduct of their administrative functions. For many commodities, the point of origin of farm deliveries to commercial markets is recorded and data are summarized to provide small-area statistics.

Not all commercial marketing statistics are produced by the operating departments as by-products of their work. The DBS has a large number of monthly, quarterly, and annual surveys, most of which are of the census type, but all of the mail questionnaire variety. Annual census of industry surveys were started in 1918 when the DBS was established and commodity data by industries became available as by-products of these survey studies. Monthly and quarterly surveys were started as needs arose and the development has been particularly rapid since the close of the last war. These surveys are integrated as much as possible with those of other

departments.

## Appraisal of Present System

## Census of Agriculture

The Census of Agriculture is a key factor in the present system. In general, four purposes may be ascribed to the Canadian Census of Agriculture: (1) to provide small area data; (2) to provide benchmarks for intercensal mail surveys; (3) to provide data on the structure of Canadian farming such as number, type, and scale of farms, enterprise combinations and capital formation and, (4) to provide data for sample design. Because of the cost of collection and the difficulty of adequately training the army of enumerators required for the census, there has been a persistent effort beginning in 1951 to limit the number of questions on the census schedule and to include only questions for which reasonably reliable answers can be expected. This, of course, limits the scope of small area data available in Canada because the Census of Agriculture is the

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principal source of such data. The frequency of censuses obviously is also an important factor in the small area data program in Canada.

The function of providing benchmarks for intercensal estimates to some extent also provides data for small areas. Intercensal estimates are provided on a provincial basis and benchmark data are required for areas within provinces to permit geographic stratification in the derivation of provincial estimates. Also, where the proportion of farms having particular crops or livestock, for example, is small and the farms are scattered, a complete census is needed to provide a reliable benchmark. Thus, the provision of small area data for other uses, coincides in large measure with the need for benchmarks for intercensal surveys.

The chief reason for extending the quinquennial farm census of 1956 to cover all provinces was the need for benchmarks for intercensal mail surveys. Ten years had been found to be too long a period without a check on the level of the intercensal statistical series. Changes in number of farms, in their scale of operation and in the incidence of production have been rapid in recent years and current data estimates were getting seriously out of line over a 10-year period. There was also a concerted demand for small area data in the 1956 census but the policy at the time was to provide for only limited needs. A sample survey was promised to obtain financial data at the provincial level and an understanding was reached that the 1961 census would be of larger scope.

Data on the structure of Canadian farming are needed by provincial governments in connection with local production programs and also by market analysts who attempt to estimate demand conditions in market areas. Much of this information is needed by small areas. To produce the kind of data required, detailed questions must be asked even though the detail is not itself necessarily in demand for small areas.

Census data have been utilized in designing farm sample surveys for many years. For the most part, however, this use of census data has been largely confined to construction of mailing lists with geographic and area-size stratification. In more recent years, area sample and list sample frames have been developed with census data as the principal basis. There is much to be learned in Canada about the structure of the farming industry, and data from the census permitting classification of individual farms and farm areas by type and scale of operation would seem to be essential for efficient sample design. Quite apart from data necessary to classify potential sampling units, estimating procedures may be made more efficient if suitable data on particular aspects of farm operations and family living are made available from the census. For example, the sampling error of an estimate based on measurement of the change from the census period may be smaller for a given size of sample than that for

an estimate made without reference to preceding census totals. Such change estimates, which belong to the ratio-estimates family, are possible only if the necessary data for the universe are available. Therefore, counts of specific items or operations on farms may also be a requirement in the census for later sampling purposes. Certainly resources for agricultural statistics are limited and the efficiency of possible sample design is of the utmost importance.

The scope of the census, therefore, may not rest solely on the need for data for small areas. The rate of change in size, number and activities of farms may continue to be so rapid that census counts at five-year intervals at least will be necessary to adequately measure such changes and to provide a stable reference for probability sampling as well as for mail questionnaire non-probability surveys.

The decision of what to collect in the census will become increasingly difficult because of ever-rising costs but intensive study will be required to make sure that alternative methods will provide the information required to solve the many farm problems which arise.

#### Mail Questionnaire Surveys

Some of the advantages of mail questionnaire surveys have been mentioned earlier. Their relatively low cost and timeliness in collection are well-known. The bug-bear, however, is the unknown total error generated in their use.

In Canada, with few exceptions, the samples obtained by mail questionnaire are used to measure changes from fixed bases. In only the exceptional case is a sample blown up directly to represent the universe and then only after careful attention is paid to use of meaningful stratification. For some years, the "matched-farm" ratio has been used as an indication of change. This involves either asking current historic data in the same schedule (one survey of this kind in Canada) or laboriously pairing returns from current and immediately preceding surveys. Attention, of course, is paid to geographic and size strata. The paired farm method has inherent weaknesses due to the non-random nature of the sample and the instability of the farm universe itself. For example, if farms decline in number, as has been the case for some years now, it is difficult to obtain a correction for the "nil" reports which should be in the current sample. The sample itself is often biased and the changes indicated by the sample of respondents may not be the same as for the non-respondents.

Much more information is needed about non-respondents in order to appraise the quality of data produced by mail questionnaire. With the list frame available in DBS some mail follow-up work has been undertaken and also a limited amount of field follow-up. The little evidence availa crops, For c error. veys. and w estima

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available from such tests indicated, that for estimate of acreages of major crops, non-response was not a significant factor in the error of estimates. For crops grown by fewer farmers, non-response error was lost in total error. Again, we face a dilemma in the use of probability interview surveys. How much, if any, would the estimates for major items be improved, and what would be the cost in sampling at high rates to produce reliable estimates for minor items even for large domains such as a province?

In actual practice, for the June and December acreage and livestock estimates, efforts are made to obtain a large sample. By use of the census mailing lists, with one mail follow-up in one week's time, an average return of 25 per cent is received for seven of the provinces. In Ontario, rural route delivery yields a 10 per cent return but distribution in Quebec, through schools, still gives us a very high response. Large returns, of course, do not ensure accurate statistics but it is necessary to point out that for certain items, a high volume of returns would be necessary even if the sample were a probability one. Present policy dictates that estimates be made for a full range of crop and livestock items and sample size, be it a probability or non-probability survey, may be excessive for certain items and barely large enough for others. To separate the items into categories and undertake surveys at differing sampling rates, would likely prove more costly than doing the larger survey at one time. This thesis, however, depends upon what is wanted. If people can be persuaded that items difficult to sample are not needed or if wanted, need not be too accurate, then the choice is made easier.

## Interview Probability Surveys

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The interview probability survey is only in the development stage in Canada in the field of farm statistics. It has not yet been seriously considered as a substitute for mail questionnaire surveys. As mentioned earlier, an area-sample frame for farm surveys was constructed and used for the first time in 1956 for a quality check of the 1956 Census of Agriculture. Sampling rates were low and the efficiency of census sample ratios proved not as high as was expected. This reduced efficiency of theoretically efficient ratio estimates resulted from reporting errors and difficulties of drawing from the census the farms corresponding to the area segments in the quality check sample. Sampling errors plus other errors of a compensating character were therefore relatively large and appreciable differences between the census totals and sample estimates could not be attributed to census non-sampling error.

The work involved in designing the sample for the Income and Expenditure survey has demonstrated that there is still a wide gap to be bridged between theory and practice in sampling for agricultural data in

Canada. More knowledge is necessary about the variability of items in the universe and the correlation between related items. The latter knowledge is necessary if effective use is to be made of ratio estimators which theoretically are efficient tools to employ. A great deal of research and study will be necessary before interview sample surveys could be used to supplant the mail questionnaire surveys currently in use. To gain this knowledge is a slow process unless more resources are made available.

Apart from the cost of preparing for the implementation of a program of interview probability surveys, the actual cost of such surveys must be considered. Though not as expensive as a census, they are much more costly than mail questionnaire surveys. Estimating very roughly, field work alone would total over \$2 million annually for the 64 farm mail questionnaire surveys undertaken by DBS. This is a sum four times greater than the total cost of collecting and processing all current farm survey

data at the present time.

Cost of course must be measured against quality of data and its utility in problem solution. We, however, are not at a point in Canada where we can say that interview surveys in practice can provide more accurate data than are being produced by cheaper methods. Timeliness must also be considered and a large field force would be required to duplicate the speed with which mail questionnaire replies are returned to DBS. Within a relatively short space of time, up to 70 per cent of the list of correspondents in special surveys return their completed forms.

## Other Methods for Farm Statistics

There is a group of statistics mainly in the fruit, vegetable and forage crop seed field for which collection is undertaken by Department of Agriculture inspection staffs. These staffs prepare production estimates of forage crop seeds and for fruits and vegetables in some provinces. Methods vary, but in general, percentage changes from the previous year are determined by inspectors on the basis of their own observations. Later in the season, when marketing data become available, a check in made and generally revisions are required, especially for forage crop seeds. Statistics based on these judgment observations are often not too accurate, not necessarily because the observer is incompetent in interpreting what he sees, but because the variability in yield and lack of knowledge of acreage changes may lead to false conclusions about the universe as a whole, i.e., the sample of observations is not representative of the universe. Where production is concentrated in specialized areas, actual counts of acreage or numbers of trees are made and quite accurate estimates of production are obtained for the specialized area, but not for the universe as a whole These counts can be very costly, however, and the cost is often masked

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under the general heading of inspection work. Given the same resources and the integration of such statistical work with planned sample surveys much improvement could result. A start has been made in this direction for fruit and vegetables statistics in one province. However, a major collection problem exists in estimating forage crop seed production because of the wide scatter of producers and the uncertainty of harvest.

## Commercial Statistics

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whole. masked Commercial statistics are an important part of the over-all system of agricultural statistics. It is not our intention here to appraise the methods of their collection because such a significant part of them occurs as a by-product of government administrative functions. A comment on the danger of relying on commercial statistics alone for problem solution follows. But it perhaps should here be noted, that commercial statistics do provide useful checks on farm statistics since commercial disposal is a major component of production.

## Future Developments in Agricultural Statistics in Canada

The future developments in data collection in Canada will depend upon many factors. Demand for data in all its aspects will, of course, be a major consideration but of equal importance will be the resources available to not only carry out established programs but to improve existing methods and to develop and put into practice new methods.

Aspects of demand such as timeliness, frequency, accuracy and intensity of coverage have been mentioned above. Other considerations have to do with kinds of statistics and their use. For instance, will the emphasis on needs for data shift from supply-demand analysis of commodity data to studies of the structure of the agricultural industry in solving social and economic problems of farmers?

Before indicating what we expect the demand for statistics to be, a word about determination of need is in order. The description of the system of collection of agriculture statistics just outlined illustrates that DBS has a major responsibility in decision-making concerning collection of data. However, other federal government departments, universities, provincial governments, business and farm organizations, all must play a part in presenting their demands and in cooperating with DBS in meeting the needs. Committees composed of users of statistics, co-workers on production of statistics, and professionally-trained people, have been established to this end. Despite the work of all concerned, there still exist many unknowns about requirements and their priorities and about methods of collection.

Available resources are spread too thinly in Canada to do the job that is

required in determination and assessment of need and to do the necessary research to improve and develop methods of collection and estimation. Within DBS the existing program leaves little time for research work. This is a common complaint of all statistical agencies. The statistical agency can never function with maximum efficiency without the full cooperation and understanding of users. This includes development of new techniques for gathering and analyzing data.

It is expected that there will be an increase rather than an abatement in demand for commodity statistics, both at the farm and the industry level. If present trends are any indication, the needs will include greater frequency of collection, more timely data and requests for more information for small areas.

In this connection, administrative statistics produced as by-products of non-statistical functions and the industry commodity surveys undertaken by DBS are important. Often the administrative data are collected primarily for markets' information purposes but they are being used extensively in forecasting the future supply position of various farm products. Their use for forecasting total supply is realistic for farm products for which commercial supply is a dominant part of total supply. There is danger, however, in reliance on only commercial statistics for farm products for which the proportion entering commercial channels is not dominant or fluctuates widely from period to period. Data on total production and distribution are necessary at intervals, perhaps quarterly and annually, to indicate changes which may be occurring in the total commodity situation.

There is danger too that too much reliance may be placed on commodity statistics for planning agricultural programs. A fundamental weakness is disregard of what is happening to the farm industry as a whole with respect to such elements as number, type, size and internal organization of farms. Commodity statistics must be bolstered with adequate information about the structure of the farming industry to establish and appraise agricultural programs.

Admittedly, considerable effort is required to define the farm industry and sub-industries within the farm sector and to provide the various segregations of farms where problem areas exist. It is now evident, however, that users will request more information about the structure of agriculture, farm practices and financial aspects, and that these requests will be backed up with demonstrated need for such data.

The key to an improved and expanded statistical program will be the availability of resources. Because of the lag in obtaining funds, it is unlikely that the relatively inexpensive existing method of collection by mail will be scrapped for some time. New resources made available will be used to add to the existing over-all system and to develop new methods.

The increasing emphasis on data requirements to solve problems both

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social and economic at the farm level points up the need for concerted effort to improve and expand farm surveys of all kinds. It is possible that the census for instance, will need to be expanded in comparison to that of 1951 and certainly in contrast to 1956. The principle of integrating the probability sample farm survey with the census will no doubt be continued. Questions will be assigned to the census and sample surveys on the basis of the ability of each to provide the data in an efficient manner. Probability sample surveys may be used to a limited extent in providing current statistics but because they are relatively unwieldy instruments to set in motion, it may be some time before their use for this purpose in Canada will be significant. Therefore, the census will remain the major source for benchmarks for mail questionnaire surveys. Such benchmarks are needed for crop districts within provinces for stratification purposes, and in some cases, for actual estimates. It would be costly to sample at high rates to obtain such data and in many cases full census counts would be necessary. The quinquennial census, therefore, will remain a necessity in the foreseeable future in Canada. This, of course, will provide a means of obtaining small area data, but it is likely that concerted efforts will be made to limit questions to those meeting only the most pressing needs, because of the high cost of field enumeration. The practice of sampling a portion of the farms while undertaking regular census enumeration needs further investigation. This device, in the 1951 census was, as a whole, satisfactory.

## DISCUSSION: PRESENT AND FUTURE PROGRAM FOR AGRICULTURAL STATISTICS IN CANADA

STERLING R. NEWELL
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The Dominion Bureau of Statistics and the Agricultural Estimates Division of the United States Department of Agriculture have many problems in common. Both face the continuing pressure for more information on more items and the breakdown of our statistics to smaller and smaller geographic divisions. As the use of our statistical product becomes more vital to the decision-making process, experience is that the demand for greater precision in the estimates now provided becomes of greater importance than the addition of new series. Both run into the difficulty, however, of obtaining the necessary facilities to institute or adopt methods which will meet this ever-increasing demand.

It helps to stimulate interest if a discussant can pick up a controversial point and stir up a good argument. For the most part though, there is little in the paper by Holmes and Parker that provides such a handle.

We in the United States are also in the preliminary stages of coming to grips with the problem of introducing probability sampling into our operations. Up to now we have been able, only in a limited way, to incorporate it as a part of our regular procedures in the service. It is not because we haven't recognized the problem and tried to do something about it. As long ago as 1937, John B. Shepard of the Crop Reporting Board outlined the needs in an article in the Journal of Farm Economics, (May, 1937).

Agreeing that the use of mail schedules from voluntary reporters will continue to be an important part of our service, the limitations of this method must be recognized and efforts must be made to develop a program that will fill the vital gaps now wide open and, at the same time, provide a basic framework for improvements in the present voluntary reporting system.

One of the main problems is that present methods cannot provide a very dependable basis for estimating changes in the number of farms. Yet, this figure is a necessary part of some of the most important estimates that are made, both in the Dominion and in the United States. Consider livestock estimates. The main difficulty with those estimates is the sharp trend in the number of farms keeping various species of livestock. Mail surveys tell pretty well what the per-farm averages are for farms keeping livestock, but the weak spot is the number of farms to which those averages should be applied. Even if a sample only large enough to give us a good indication of the numbers of farms keeping livestock, by states, could be enumerated we would be in better shape than we are now.

The Agricultural Estimates Division, USDA, had a good experience in the problems of combining mail and interview surveys this summer when it faced the problem of how to take care of the huge 1958 wheat crop. A heavy mail survey was conducted in eight of the principal small-grain-producing states to estimate the farm storage capacity for small grains and ear corn. At the same time a small 1000-farm probability sample covering the eight-state region was enumerated. The absolute levels of the storage capacity resulting from the two surveys were different. The individual state estimates from the mail survey were adjusted to bring the totals from the eight-state area in line with the interview results. Later investigation showed that the main difference between the mail and interview surveys was caused by differences in the way farmers interpreted the term "available storage space." In the interview survey the enumerators had a set definition to follow but farmers were left with their own concepts when they made their mail reports.

The investigations carried on during the past five years under the division research and development program help us conclude that

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if we are to keep abreast of the rapid changes taking place in agriculture and meet the ever-increasing needs for more accurate statistical facts, it will be necessary to increase the use of interview and probability sampling.

The Agricultural Estimates Division, in February 1957, promulgated a comprehensive plan for the development and improvement of the agricultural estimating service in the United States. Briefly, the plan is based on the use of interview techniques on a probability sample to obtain acres of crops planted, livestock numbers, farm labor, and the use of interview techniques for the collection of certain price data. In addition, the plan contemplates the extensive use of monthly measurements of plant development during the growing season as the basis for developing more accurate early-season yield forecasts.

Holmes and Parker point out that this type of program is going to be more expensive and difficulties in getting the funds to put it into effect will loom large. This is so true. But expense is a relative matter, and if one stops to consider the cost of a wrong decision in agricultural policy or the cost of wrong decisions at many points all along the line between the producer and consumer, the cost of adequate and reliable statistical facts becomes relatively insignificant. A program may have to be developed bit by bit over a period of years, but sooner or later we are going to be forced to do the job as well as we already know how to do it.

# CURRENT AND AREA DATA PROGRESS AND FUTURE NEEDS IN THE UNITED STATES

J. CARROLL BOTTUM AND JOSEPH ACKERMAN
Purdue University and Farm Foundation, Chicago

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PROVIDING data on agriculture is an old and basic service of the United States government. The growth of the work in this country has been slow and irregular. New work has usually developed in connection with particular problems or situations and additional resources for the work have been provided largely for specific projects or problems, usually

associated with periods of difficulty in agriculture.

Two main systems for the collection and processing of agricultural data have been developed. These are: (1) the agricultural census which has enumerated basic magnitudes for the industry at 10-year intervals from 1840 to 1920 and at five-year intervals since then, and (2) the vast sampling system of the United States Department of Agriculture for making current estimates and measuring short-time changes through a continuous program of data collection, so far largely by mail. It has been pointed out that the two systems are complementary, each serving areas of importance.1 Also, the two are interdependent in that census enumerations are the benchmarks for many of the current estimates made from samples by the Department of Agriculture. In addition to full enumerations by the Census of Agriculture, some sampling has been done as a part of these enumerations beginning with the wartime Census of Agriculture in 1945. In 1950 and 1954 the agricultural census enumerations included sections of sample questions which were asked on every fifth farm plus large farms, thus providing at least a 20 per cent sample for the items in the sample sections. Sub-sampling by mail based on census listings has been used by the census following several five-year enumerations. In early 1956 a sample of about 12,000 farms reporting in the 1954 census was used for a personal interview survey on farm expenditures.

Growth in agricultural data work has been stimulated from time to time by additional demands associated with periods of need such as war, depression, or government programs to bring about adjustments in agriculture and overcome problems of low prices, surpluses, etc., in the farm economy. Some developments came during World War I, notably the cooperation in agricultural data collection between the Department of Agriculture and the states. During the decade after 1920 state offices grew and progress was made in collecting livestock and crop acreage data through the rural mail carriers. Also, the collection of basic data was

<sup>&</sup>lt;sup>1</sup> W. H. Ebling, and H. L. Ahlgren, *Journal of Farm Economics*, December, 1954, p. 1226.

largely decentralized from Washington to state offices. The farm programs of the 1930's brought numerous demands for data, especially for small areas such as counties and county subdivisions. Again during World War II new requirements for data emerged in connection with programs to stimulate the output of food and fiber products to meet wartime demands. After the war when the needs for farm products eased, government programs took the form of again supporting prices and restricting production, which called for further data. In recent years important new farm programs such as those of agricultural extension, the Soil Bank, and others have emphasized the need for certain types of data, particularly data for subdivisions of states such as counties and townships.

#### The Growing Place of Data

As agriculture has become more and more commercial with fewer but larger farms producing the nation's food and fiber, clear thinking and decision making have come to require a continuous flow of information not only for local production areas but also for more distant ones. Technological advances have also increased the importance to agriculture of farm supply, processing, and marketing firms, including fertilizer companies, feed companies, railroads, banks, packers, etc. These technological advances have resulted in the need for better coordination of the various steps in production and distribution. Each organization which performs one of these steps is dependent on current information not only regarding present supplies but also the probable future situation. Anyone who assumes risk in these operations requires knowledge of long-time as well as short-time trends and in so far as possible of the supply and demand prospects for the immediate future.

Just as data by which the situation can be determined well enough for decision making by producers and distributors have become increasingly important, so a flow of data is also required for investigation and administration by government agencies. More and more the execution of farm programs and the planning of research and investigations require implementation with the necessary data.<sup>2</sup> Hence, we have a growing place for such material and a constant need for reappraising it in terms of the newer requirements. Practically everyone in agricultural production, distribution, research, or administration is limited in his own opportunity to make observations or gather primary facts. Only as systematic efforts can bring together the observations and judgment of many persons throughout the agricultural universe can individuals be equipped with the knowledge needed for effective planning and decision making. The data systems

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<sup>&</sup>lt;sup>2</sup> See K. H. Parsons, *Journal of Farm Economics*, November, 1949, p. 685, on usefulness of data and adjustment to research needs.

in agriculture serve this basic function and it is important that they continue to develop as needed for new programs and changes.

## Continuous Study of Data Problems

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Because new problems in agriculture continue to arise requirements for data have changed and will continue to change. The volume of this material has increased greatly and with experience the quality has improved. Wider coverage of needed items and fuller publication of data collected have characterized recent decades. Methods, too, have been improved materially, and a continuing program of research is under way for further improvement both in Washington and in some states. Both the Census Bureau and the United States Department of Agriculture have internal and outside committees reviewing data needs and methods problems. More cooperative work with the states is being undertaken. In the last decade, expansion of this work has become possible under the fund matching provisions of the Research and Marketing act of 1946. Encouraging as this development has been, the progress has been slow and spotty. The demand for data has far outrun the ability of the agencies to supply them, and it is urgent that steps be taken to meet the growing needs.

The American Farm Economic Association (AFEA) and other societies have had census advisory committee for a long time. In 1954 a committee on agricultural data was appointed by the AFEA. One of the objects of this committee was to survey the requirements for data by users and to suggest areas of development and improvement. Surveys regarding the types of data desired were made and these showed a major growth in demand for local or small area material, partly as a result of new agricultural programs, especially those of the agricultural extension service such as farm and home planning. Other developments such as the Soil Bank added to the need for local data as a basis for developing effective programs. The greater tendency in recent years to promote local study and self help in the extension programs appears to be a new possibility for meeting the growing requirements for local data as compared with state or national. The most recent survey (1956) showed that about two-thirds of the agricultural demand was for local area data, a significant increase in this area as compared with the results of a similar survey made two years earlier.3

The data committee also made other surveys to determine what data needs were not now being met. These brought out various suggestions such as more frequent data on livestock and in certain months on crops such as fruits, vegetables, and others. Also, the surveys showed a growing

<sup>&</sup>lt;sup>3</sup> Unpublished report, Agricultural Data Committee, American Farm Economic Association to USDA and U. S. Census Bureau, January 1957.

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interest in data on farm production practices and farm equipment, particularly the rate of adoption of some of the newer practices and equipment. More details on the changing size of the farm enterprise, including part-time farming, were frequently mentioned. Likewise more information on irrigation and nonirrigation production is needed in the western states. Additional facts on the movement of farm products and their destination and utilization are desired. Some states want more data on forestry and forest products. The need for price information by grades and classes was emphasized in some areas. Data on farm family living and community characteristics as well as farm income, including earnings from off the farm work, and more detail on farm family expenditures were listed. Types of data wanted in different states varied greatly and we can readily see that new developments constantly cause unfilled gaps in the material needed.

Along with these requests for local data, a need was expressed for greater accuracy and more rapid release of the current information provided by the department of agriculture under its crop and livestock estimating program. Farmers and those organizations serving agriculture are increasingly dependent upon accurate information relative to developments affecting their industry.

#### The Importance of the Five-Year Census

Current USDA estimates for many items in agriculture provide mainly state and national data. Local data, which according to surveys account for about two-thirds of the volume of new data requested, have been obtained mainly from the Census of Agriculture at five-year intervals and such county estimates as the state agricultural statisticians can make from current samples, state assessors' enumerations and reports, and other sources, often using the census data as a base for the estimates. A great deal of needed local data can still only be supplied through censuses at five-year intervals.

In addition to providing the bulk of our present local data in most states, the census enumerations also establish the benchmarks upon which the Department of Agriculture depends for projecting state and national estimates. Reliable numbers for various agricultural populations established through enumerations by the census at five-year intervals are projected up or down, depending upon the direction and degree indicated by the samples which are regularly collected.

In addition to providing agricultural data for benchmark purposes, the census, of course, serves other important purposes. Data on minor crops are difficult to obtain except through periodic complete census enumerations. Local detail for areas which have become of great importance in local programs and others having nation-wide programs organized by

counties is recorded. The farm press in appraising the farm market often relies on data for small areas. Business firms often use small area data in studying the location of plants or sources of raw material or labor. The Census of Agriculture is widely useful for many purposes because it provides data on many items for small areas in addition to data for states and the nation.

Since so large a part of the demand for data is for local information, it is not surprising that proposals to eliminate the five-year Census of Agriculture and substitute a series of annual samples, raise objections. This issue has been reviewed in a recent paper. The writers of that paper review the history of the idea of a sample census and again propose that the quinquennial census be replaced by a series of annual sample censuses during the decade following 1960.

The plea is made that the annual sample census might make possible a greater volume of improved county estimates on an annual basis.

More funds for agricultural data are difficult to obtain; hence, it is proposed to use the funds allocated for the quinquennial census for a decade of annual sample enumerations to provide measures of change or trends.

For many in agriculture and elsewhere this seems undesirable. When it comes to county data it is doubtful that these can be supplied adequately without the usual complete census enumeration at five-year intervals. The 5 per cent samples proposed would not do the job well enough. In view of the importance of programs for which county data are used, the 10-year interval between the decennial census enumerations is too long. This brings us to the question of which is more important, additional samples to measure change in additional agricultural data fields or an enumeration at five-year intervals to provide needed area data as well as benchmarks.

The new idea has appeal. But it should be noted that if annual census samples are to provide data on acreage and production of crops and livestock numbers, many of the questions are likely to be the same as those which use most of the questionnaire space in the regular census. Repeating standard census questions means that only a small part of the space can be available for new material. The results might well be disappointing to those who are looking for a flow of new data on agriculture. The sample censuses would likely result in better annual data for a limited

<sup>8</sup> See paper by M. R. Benedict and G. M. Kuznets, joint meeting of the American Farm Economic Association and the American Economic Association, December 28, 1957.

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<sup>&</sup>lt;sup>4</sup> A statement of the proposal to substitute annual samples for the five-year Census of Agriculture can be found in the report, entitled "Appraisals of Census Programs," by the Intensive Review Committee of the Secretary of Commerce, February, 1954, p. 8.

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can 28, number of items on only a state and national basis at the expense of a broader number of items with much more local data on a five-year basis.

## Who Should Do The Sampling?

The Department of Agriculture already has a large and important sampling program, one of the finest. If the object is to improve the present estimates through the use of different sampling, enumerating, and estimating techniques, this should probably be done in the Department of Agriculture and not in the Department of Commerce. Certainly, if many of the same agricultural items are to be measured by two separate sampling agencies costs would be increased and differences in the results would be troublesome.

Sample enumerations are, after all, not a census but merely another means of making estimates. The question of a jurisdictional issue between two departments taking samples on the same subjects would seem to suggest that the census sampling proposal for agricultural items is unsound as a government procedure. If additional sampling is to be done in agriculture, it should probably be done by the Department of Agriculture, which has had almost a century of experience with a strong nation-wide sampling program in cooperation with the states. Any changing and strengthening of the program should also be done here and not through setting up another vast sampling project in another agency. The needs cannot be met by one general purpose sample. Many different types of samples would be needed to adequately cover the various phases of agriculture.

Analytical work in agriculture has been done mainly in the Department of Agriculture and the state agricultural colleges (including experiment stations and extension services). Close association of the analytical work and the sampling for agricultural data has resulted in distinct gains, as each has complemented the other. If the sampling program were moved out of agriculture, the analytical work would tend to follow the sampling program. This does not seem logical either from the standpoint of governmental efficiency or from the standpoint of agriculture's best interests. The Department of Agriculture and state college analysts seem to be in the best position to make analyses and to contribute to improved technics of agricultural sampling, and are constantly making sample surveys. These special surveys and analyses are appraised and may later, if proven sufficiently valuable to the public, become incorporated on a national basis.

The Department of Agriculture has recently submitted to Congress a long-range program in agricultural statistics<sup>6</sup> to further strengthen the

<sup>\*</sup>See Department of Agriculture appropriations for 1958, hearings before the sub-

work in this field. This program, if implemented, would greatly expand the sampling work, particularly in the field of sample enumerations by personal interviews, using many of the techniques suggested by the sample census plan. It is aimed at providing a basis for meeting unfilled needs for agricultural statistics as well as improving the timeliness and accuracy of many of the present series. This proposal would implement a program of more adequate local data and would provide the framework for making additional sample surveys as needed by the various segments of agriculture.

# DISCUSSION: CURRENT AND AREA DATA PROGRESS AND FUTURE NEEDS IN THE UNITED STATES

ROY A. BODIN

Minnesota and U. S. Departments of Agriculture

The authors have provided us with an excellent description of the development and functioning of the two major systems within the government for collecting agricultural data. To date these systems have been largely complementary, but concern is expressed over proposed plans which will likely lead to costly overlapping of effort, conflicting results. and a sacrifice of local data, both in quantity and quality. I share this concern which stems mainly from proposals to eliminate the 5-year Censuses of Agriculture and the substitution of an annual sampling process within the Bureau of the Census. For some agricultural items, there is no better proven method than the census approach designed to enumerate all units of a given universe. Unfortunately, censuses are time-consuming and extremely costly. Even so, the usefulness of the census approach is being given greater recognition by the state and federal departments of agriculture in the development of many new procedures for improving the quality of agricultural information, particularly of the local type. These agencies, through cooperative working arrangements, have had many years of experience in the use of both census and sampling techniques.

Many states have their own annual censuses for developing current information on number of farms, land usage, livestock production and other basic items. For years these state-sponsored censuses have served the very useful purposes of strengthening the estimates for the various states and of providing much needed district, county, and even township

committee of the Committee on Appropriations, House of Representatives, eighty-fifth Congress, p. 886. Also, "A Program for the Development of the Agricultural Estimating Service" by U. S. Department of Agriculture, Agricultural Marketing Service, February 1957.

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data. In Minnesota, this has been a continuous process since 1922. It is difficult for me to foresee general support by Minnesota agricultural interests of proposals which might jeopardize continuation of this service. This could happen if the proposed programs increase duplication, which seems highly probable, in collecting basic facts. There is already too much of that. It is extremely irritating to farmers and others to be repeatedly approached for information; especially when the questions are, or are very close to being repetitious. I do not visualize funds adequate enough to maintain systems which create and continue such conditions.

With increased specialization, the departments have found it increasingly difficult to develop adequate estimates by sampling alone. For many items, estimates are made from indications developed through sampling of the smaller units and an actual enumeration (census, if you please) of units above a significant size. In other words, the homogeneous part of the universe is sampled, while the area of greatest dispersion is enumerated. This technique is used for grain in commercial storage, hatchery production, and other items which are heterogeneous. With more adequate financing, this procedure could be used to excellent advantage for additional subjects. In view of this trend toward greater use, based on necessity, of the census approach in numerous estimating procedures, it hardly seems logical to embrace a plan which would replace the quinquennial census with an annual sampling technique.

Mention is made of the broad demand for local data. This need cannot be overemphasized. From the beginning, the informational service work of the Minnesota and U. S. Departments of Agriculture has been primarily concerned with the basic subjects of land use and livestock production. More recently, the state sampling and census programs have embraced other important subjects, such as prices received and paid by farmers, grain in storage, utilization of crops, marketing, and production practices. Through use of matched state and federal funds as provided for by the AMA act of 1946, it has been possible to expand the scope of reports to better serve persons concerned with the local problems of marketing agricultural products. This work in Minnesota included the subjects of turkey losses and causes, crop production by varieties, annual county estimates of the fall and spring pig crops, milk, and egg production. For these projects, it has been necessary to employ special techniques adapted to local conditions. These needs for specialized local service and information cannot be met through general purposes samples, whether done by the Bureau of the Census or the Department of Agriculture. Obviously, the authors had this in mind when they stated "the needs cannot be met by one general purpose sample."

The numerous uses made of census data are rather common knowledge. Specifically, the use of such data as benchmarks by the Department of

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Agriculture in establishing estimates is extremely important. Looking forward, it will be more essential than ever to have accurate data on number of farms, land in farms, number of farms producing various crops, livestock and livestock products. Such information is most useful when stratified according to size of operation. Aside from all other uses which it may have, census information is essential to the development of general purpose and specific subject samples in sampling procedure. Due to the dynamic nature of agriculture, 10 years is much too long a period to wait for basic census data.

Any system for collecting agricultural information should embrace an acceptable approach to the farmer. Farmers and related industries are accustomed to cooperating with the state and federal departments of agriculture in the matter of supplying current data at frequent intervals; also in receiving information in return from these agencies, the Agricultural Extension service, experiment stations and others primarily serving agriculture. It seems reasonable to advocate a continuation of this proven relationship. It seems more logical to approach a farmer for his business information by use of an introduction embracing the Department of Agriculture rather than the Department of Comerce. The degree of willingness to cooperate in giving information, or even access to premises in the case of objective surveys, is a critical feature in the accuracy of data.

To be of greatest value, information must be timely as well as accurate. Claims have been made that national sampling plans will speed up availability as well as improve the accuracy of the data. Both of these contentions remain to be proven. There is doubt that their adoption will lead to a general speed-up in availability of information. Much of the data now collected by agriculture would be required on a current, quick basis even though sample census and other national sampling procedures are inaugurated. A great deal of the information assembled currently is being satisfactorily collected by mail, the quickest and cheapest method available. The initial mailed returns are often supplemented with information gained by telephone calls, second requests, personal visitation and other means. These efforts are closely related to the importance of the subject, the sampling problems and available time. For most items, the time allotted for collecting, summarizing and analyzing of data is the barest minimum. This is recognized by regulations applicable to crop reporting board procedures.

I have had direct charge of a number of interview surveys made in Minnesota as part of National Research samples, including the 1956 survey on farm expenditures mentioned by the authors. These interview surveys have been slow and costly projects. Frequently, emergency situations arose which seriously disrupted progress. The interview process is

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usually so complicated that it is extremely difficult to obtain strictly comparable data between enumerator areas, even following extensive training and experience for enumerators. Too often it is necessary to rely on well trained office technicians to do a satisfactory job. It has meant, too, the separation of the analytical work from the data collecting process. The authors stressed the desirability of retaining the collection and analytical processes in the same agency. I go further to emphasize that these two functions must be very closely correlated within any agency for best results. This is based on the observation that, while complete objectiveness is a highly desirable feature in sampling procedures, it is seldom, if ever, fully realized in practice because of the human element. It is well nigh impossible to develop a utopian plan which will satisfactorily meet all the requirements when placed in operation. Hence the work of planning, collection and analysis should be closely correlated. Except possibly for the general censuses, I believe these functions can best be done by agriculture for agriculture.

Earlier, it was implied that flexibility is imperative in the collection process. Actually, it appears desirable to maintain and even expand the flexibility present in the current systems developed by agriculture in close cooperation with state agencies. Rigid, centralized control at the national level, a characteristic of proposals involving national sampling, seems to rule out this needed flexibility. In conclusion, I suggest that proposals which present national sampling as a panacea for agricultural data need be very carefully examined before adoption to avoid the danger of having agricultural interests learn too late that, in essence, they may have thrown the baby out with the bath water.

#### PLANS AND PUBLICATION OF STATE AND LOCAL DATA FOR THE 1959 CENSUS OF AGRICULTURE

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RAY HURLEY
U. S. Bureau of the Census

THE need for a nationwide and complete Census of Agriculture in 1959 appears unquestioned. Major changes are going on in agriculture as farm people adjust to economic growth and progress. These changes have been of greater magnitude during the last 20 years than during any other period of our history. Undoubtedly, during the last five years, there has been a rapid, if not a greater adjustment, than during any similar five-year period. Agriculture is an industry made up of more than four million individual farms, each an individual business with its own manager. Each farm is operated as an entity. Control over agriculture, its changes and its production is, therefore, vested among millions of individuals. A census is required to measure and to indicate the nature of these changes. Widespread interest in changes, technological developments, and rapid adjustments, assure the taking of a nationwide Census of Agriculture in 1959.

Planning for the 1959 census began a year ago. Plans have been developed by inviting criticisms of previous censuses and securing suggestions and recommendations from a large number of persons and agencies. These plans for the 1959 census may be outlined in three parts—namely, questionnaire, enumeration, and tabulation and publication of results.

# Questionnaire

The development of the census questionnaire is now practically complete. Last year, many of the principal users of Census of Agriculture data, such as state agricultural colleges, state departments of agriculture, farm publications, and others were invited to submit suggestions and recommendations for the next census. In determining the inquiries to be included on the questionnaire, dependence has been placed upon staff studies and the recommendations of representatives of the principal users of the data. To secure balance among various interests and to obtain assistance in the holding of the number of questions within bounds of farmers' and enumerators' patience, and of appropriated funds, the director of the Bureau of the Census established a special advisory committee for the 1959 Census of Agriculture. The committee consists of representatives nominated by American Association of Land-Grant Colleges and State Universities, Agricultural Publishers Association, The American Farm Economic Association, U. S. Department of Agriculture, National Council of Farmer Cooperatives, National Association of Commissioners, Secretaries, and A

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Directors of agriculture, Farm Equipment Institute, The National Grange, National Farmers Union, American Farm Bureau Federation, and Rural Sociological Society. This committee has considered the questions for the coming census and has reviewed the plans during five meetings, lasting in total, six days.

The proposed questionnaire is now being printed for use in a pilot test next November. While only three regional versions of the questionnaire are being used in the pilot test, about 40 versions are planned for the census in 1959. Each of these versions will apply to a state or to a group of two or more adjacent states.

#### Enumeration

As in 1954, the 1959 census will be taken in October and November, after the completion of the major part of the harvest. Beginning dates will vary from early October to mid-November for various sections of the country. There are three aspects of the enumeration I would like to discuss. First, we plan, as for the 1950 and 1954 censuses, to distribute by mail about a week before the start of the enumeration, a copy of the questionnaire to each boxholder in all rural areas except in southern counties which have a considerable number of sharecroppers.

We expect to secure in 1959, as we did in the 1950 and 1954 censuses, the cooperation of 800,000 to 1,000,000 farmers in filling out the questionnaire before the census enumerator calls. This voluntary assistance on the part of farmers, especially by a large proportion of those operating the larger and commercial farms, assists in getting the census taken more economically and probably more accurately.

To keep the cost of the census within bounds and to provide for broader subject matter coverage, about one-third of the information on the questionnaire will be obtained for only a sample of farms. This sample will comprise all of the farms 1,000 acres or more in size and one-fifth of the farms of less than 1,000 acres.

The taking of the census will require the temporary employment of 30,000 to 35,000 persons. Each of these will receive paid training. The local supervisor or crew leader will get five days training and the enumerator or census taker will receive 12 hours of classroom training plus one-half day of actual enumeration before he is given an assignment. Both local supervisors and enumerators will be required to make a passing grade on a test and satisfactorily complete the training course before they are given an assignment. The evaluation at the end of the training class will result in some trainees being eliminated.

The training of aproximately 2,000 local supervisors will be given by the Washington permanent office staff, and professional personnel borrowed

from the U. S. Department of Agriculture and state colleges. The local supervisor will conduct the training classes for the enumerators.

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The objective of the enumerator training will be to teach the enumerator what he is to do, to give him sufficient knowledge to perform acceptable work, and to furnish motivation for doing the best possible job. The training program will teach the enumerator the step by step procedure of doing his job and will give him the essential facts he needs to know now in order to carry out his assignment efficiently and accurately. Emphasis in the training will be placed upon practice enumeration in the classroom, use of role-playing interviews, problem-solving exercises, and filling out questionnaires. Before the last day of training the enumerator will perform one-half day of actual enumeration. Questionnaires filled out during the one-half day of enumeration will be reviewed and discussed with the enumerator.

The materials to be used for training of enumerators will be standardized and the crew leader will be required to follow a fixed time schedule in conducting the training. In order to reduce the monotony of the training and increase the effectiveness of the presentation of essential instructions, training materials will include five filmstrips presenting basic procedures, definitions, and reasons for taking a census of agriculture.

The enumeration procedures provide for the listing of all dwellings and places in rural areas outside of built-up areas. This listing will be used to identify farms and places with harvested crops or livestock or poultry. To help insure the completeness and accuracy of the census, lists of large farms will be prepared in advance of the census to insure their enumeration, and a special listing of sharecroppers and tenant submits will be made for landholdings in approximately 300 counties in the South.

#### Tabulation and Publication

Plans for tabulation and publication of the results of the census are of interest.

As the census covers practically all farms and farm production, many users look to the census to provide local area data as such data are usually not available from any other source. Present plans call for the tabulation of all items except those obtained for a sample of farms by minor civil divisions. However, many minor civil divisions contain too few farms to provide an adequate work load for an enumerator and in such cases, where minor civil divisions are combined for enumeration purposes, the data will be tabulated only for the combined minor civil divisions. However, it is expected that in practically all cases the combinations will be the same as for the 1954 census so that 1959 and 1954 data will be available for comparable areas. In 16 states (Washington, Oregon, Idaho, Montana,

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California, Arizona, Utah, Wyoming, Colorado, New Mexico, Texas, Kentucky, Tennessee, Alabama, Georgia, and South Carolina) the Bureau of the Census in cooperation with local officials has established statistical areas for subdivisions of counties. In these states data will be tabulated by these statistical areas. In all, our tabulations will provide data for approximately 32,000 subdivisions of counties. We do not plan to publish any of these data. However, such data can be made available, as for past censuses, upon the payment of the cost of preparing statistical tables from the tabulations.

Tabulations and our publications will provide data for each county for practically all the items included in the general census. As soon as the data are tabulated for a county or state they will be issued in a four-page preliminary report. These reports will begin to be available during the first quarter of 1960 and should be available for all counties and states by December, 1960.

In the 17 western states, plus Arkansas, Louisiana, and Florida, our tabulations and publications will provide, by counties, data on the crop acreage for all crops harvested on irrigated land and data on the acreage as well as production of individual crops harvested on farms on which the entire crop was irrigated.

A limited amount of data for various classifications of farms will be tabulated and published by counties. Counts and acreage of farms classified by size and by three major tenure groups will be published by counties. Counts will also be provided for many farm enterprises, showing the distribution of farms by size of the enterprise. The number of farms classified by economic class, type of farm, and detailed tenure groups will also be published. It is planned to publish, by counties, totals indicating the magnitude and important characteristics of commercial farms.

Detailed data by various classifications of farms will be tabulated and published only by states. Because of limited use and cost of compiling the data the tabulation and publication of data by state economic areas have been eliminated. Classifications for which detailed state data are to be published include farms by size, economic class, color and tenure of operator, and type of farm.

Agricultural changes, the change in price level, and the increase in off-farm employment necessitate a revision in our definition of a farm. We expect to publish data at a state level to indicate the number, acreage, and some of the characteristics of places excluded from 1959 census because of the change in the definition of a farm.

The changes in the productivity of farm labor, the combination of farming with other occupations, the shift of many farm people to full or part-time nonfarm employment without changing their residence and the in-

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crease in farm size indicate a need for a revision in the economic classification of farms used during the last two censuses. The criteria to be used for the revised classification are now being analyzed. Details regarding the revision in farm classifications as well as the change in farm definition will be made available in advance of the census.

In order to provide data that cannot be obtained either because of cost or difficulty of collection in a general census, our plans call for the collection of information on a number of subjects, especially those relating to some especially new developments and changes, by means of supplementary surveys. Data on farm mortgage indebtedness and farm taxes will be collected for a sample of approximately 125,000 farms. These data will be published by states. Information on the characteristics of farmers contracts with dealers, processors and cooperatives for the production of various farm products; on the use and characteristics of new farm service buildings constructed since January 1, 1956; on the number and use of 20 farm machines; on the amount of off-farm income received by the farm operator and members of his family from nine sources; and on the amount of farm operator debt (both mortgage and non-real estate) for farm operations will be collected in a special survey of 8,000 to 12,000 farms in the fall of 1960. This sample will provide data for the United States and for some items for three broad geographical areas.

The 1959 census will include census of drainage enterprises and of irrigation enterprises as well as the census of irrigated land use in the 17 western states, Arkansas, Louisiana, and Florida. The census of irrigation will be supplemented by a special survey of irrigation in the humid areas.

The publications planned for the next census will contain an appraisal of the results of the Census of Agriculture. This appraisal will be based, in part, on a recheck of the enumeration of a sample of 3,000 to 5,000 farms. This size of sample will be adequate to provide an accurate evaluation of the completeness of coverage within 1 per cent of the total number of farms. This recheck will not only provide estimates of the completeness of coverage of farms and land in farms but also furnish data that will help evaluate the accuracy of other important agricultural items. We hope to interest one or more agricultural colleges in participating in this recheck program. While our publication of data relating to incompleteness of the Census of Agriculture has been subjected to some criticism, we expect to continue to evaluate our census program and to inform, particularly the technical user, of the errors in the census. Our efforts in this area have been pioneering and we hope that other agencies may develop similar programs so as to lead to more accurate and intelligent use of agricultural statistics.

# DISCUSSION: PLANS AND PUBLICATION OF STATE AND LOCAL DATA FOR THE 1959 CENSUS OF AGRICULTURE

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J. L. FORSYTH

Dominion Bureau of Statistics, Canada

Hurley has told us of some of their plans for the 1959 Census of Agriculture—of how they will measure many of the changes in farming that have occurred during the past five years. In order to measure these changes, a great deal of testing and planning is necessary. While the United States Census Bureau is planning a Census of Agriculture in 1959, Canada is planning one for 1961. Consequently, there is interest in each other's methods and results. In fact, representatives from both countries meet frequently to review methods and discuss ways and means for improvement. Unfortunately, plans for the 1961 Census of Agriculture have not been developed to the stage where any official report can be made.

A description of the planning for a Census of Agriculture reveals some of the problems relating to the preparation of the questionnaires. For instance, more than 200 suggestions have been received during the past three months for changes in a list of inquiries proposed for the 1961 Census of Agriculture—each source claiming high priorities for their requests. The use of an advisory committee made up of personel directly concerned with and using census information, transfers part of the responsibility back to the users of the data, although the Census Bureau has the responsibility for the final recommendations.

During each of the last two censuses a copy of the questionnaire was distributed to the farm operator in advance of the enumerator's visit but the proportion of operators completing the form was not as high as Hurley reports. If the questionnaire was addressed to the farmer personally, and if greater efforts were made through the press, radio, farm organizations, etc., more operators might be encouraged to complete the questionnaire before the enumerator calls, thereby reducing the cost of the enumeration and improving the quality of the data.

The United States Bureau of the Census has been recognized as a leader in the field of sampling, and their plans, as outlined by Hurley, indicate that they intend to use sampling methods to the fullest extent in 1959. While a sample of farms does not provide information for small areas, it does provide, in total, more information for the same expenditure than could be collected if a 100 per cent enumeration were used.

The job of selecting and training a large temporary staff required to collect the information, features improvements in training technique, for example, active participation by the enumerator during the training

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class and under field conditions prior to the regular enumeration, and the standardizing of the material used for training, should improve the quality of the statistics.

The practice of checking information collected against a pre-listing of special holdings, such as large farms, resulted in improved coverage in the 1956 Census and this phase will probably be extended in 1961.

Hurley reports that considerable information for some 32,000 minor divisions will be made available to the users at the cost of preparing the statistical tables from the tabulations. Information for such small areas is available only from the census, and these plans should satisfy the users of such data. We have been publishing in the regular series of reports, some information for small areas and I expect this practice will be continued. The number of requests for unpublished data has increased and a charge is made to cover the cost of transcribing the data from the tabulation records.

Timeliness is an important requirement of census information and to meet this need Hurley expects that the county data will be available for all states by December, 1960. Census information is most useful if it is classified by a number of characteristics such as size of holding, tenure, economic classification, type of farm, and size of the enterprise. Many users are interested in knowing, for example, the number of farmers growing 500 acres of wheat, or milking 75 cows, or how many enterprises produce more than \$20,000 worth of farm products. We feel that greater efforts should be made to extend the classifications made of census data. Unfortunately, there are differences of opinion as to the best method for making such classifications, although, as in the United States, we too are actively studying this subject. It is one of our urgent problems for the 1961 census.

The definition of a farm is one of the most controversial subjects in a Census of Agriculture and one on which we receive considerable criticism. It is interesting to note that a change in definition is proposed for the 1959 census. While it is recognized that changes in the agricultural industry may necessitate changes in the definition of a farm, many users require comparable data for trend analysis, and unless it is possible to provide a measure of the differences due to definitional changes, comparability is not possible. This problem arose in the 1951 Canadian census and, unfortunately, only part of the decrease that was due to the changes in definition could be measured. While consideration is being given to changing the farm definition, it may be advisable to retain the same definition and extend the number of classifications to meet the different requests.

With the large number of requests received by a census organization for information, it is only reasonable to say that all cannot be granted. Hurley expects to answer some of these requests through supplementary

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surveys. Reference has been made to the reduction in the number of inquiries in the Canadian Census of Agriculture from 1941 to 1951 and 1956, and to the fact that some of the inquiries left off the latter two censuses were included in subsequent sample surveys. Recognizing the difficulties and limitations in obtaining such information as farm indebtedness, expenditures, off-farm income, through census enumeration, and that such information is not usually required for small areas, these subjects seem more appropriate for sample surveys. While the content of the 1959 census questionnaire is not known to this meeting, the 1954 questionnaire contained a number of inquiries on crop production. The Canadian experience has been that reliable production data can be secured from sources other than census, and crop production inquiries were omitted from the 1956 census. If the 1959 questionnaire for the United States contains inquiries on crop production, is it not feasible to drop these questions from the census, or is this information required for countries or smaller areas?

While it is generally understood that even with a 100 per cent enumeration data collected in a census are not entirely free from errors, it is advantageous for the user to know the extent of the variations existing in the census information. Our experience (1956 census) has been that it is very difficult to check the accuracy of livestock data, and it is interesting to note that consideration is being given in the United States to turning over the 1959 quality check to universities.

# TECHNICAL PROGRESS AND VERTICAL INTEGRATION OF AGRICULTURE

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Chairman: J. W. Fanning, University of Georgia

# ALTERNATIVE WAY OF COORDINATING PRODUCTION AND MARKETING

EWELL P. ROY
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IN ATTEMPTING to define some of the terms used in this paper, absolute technical accuracy is not the guide but more so working definitions. "Production" includes assembling various raw inputs managing them for a certain time, and then turning them loose as raw output for a subsequent stage. Upon leaving this unit or farm, "marketing" begins.

Another term requiring definition is "coordination." For example, some of the stages in the economic process consist of supplying and assembling raw inputs; combining raw inputs; dispensing of more advanced raw output as more advanced raw inputs; processing and dispensing as finished output. As a matter of fact, we are usually coordinated all along despite the complaints that the coordination is less than perfect

Traditionally we have relied upon the "open market" to coordinate these stages through the price system. Fluctuations in the price level and differentials thereto were believed to allocate resources to the optimum degree.

Some have claimed that perfect competition will do the utmost in allocating resources. In perfect competition, we assume that no firm will be significant, that no agreements need be negotiated between and among firms because it is pointless and unnecessary. We further stipulate that all farm products be made to look alike and that differentiation is pointless.

In perfect competition and in absence of formal coordination, two defects appear; one, that wide swings in price and output are bound to occur as the mass of producers take exit or make entry in response to price movements, up and down. Open-markets in their day-to-day quotations do not reflect stable consumer desires but reflect extreme short-run conditions, thus producers can often be misguided in their resource allocations. Stability is hardly the word for atomistic decision-making.

Second, the fact that prices do fluctuate drastically is no proof that these prices are competitively determined.

However, perfectly competitive markets rarely ever prevailed except for perfectly competitive conditions on the seller's side or among farm producers. Firms themselves selling inputs and buying outputs of farmers rarely met the stipulations of a "perfect" market, even though the market was "open" and not formally coordinated and integrated. Farmers have

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never liked the "open market" and so-called uncoordinated markets. Why? They conclude rather intelligently that their bargaining power is weak yet they take the brunt of price and income swings. The output buyers have no such problem. They work more on "margins" not price swings and thereby want prices as low as possible so as to move more units; so as to extract margins more frequently and thus increase total net income.

Hundreds of poultry and livestock farmers have substantiated that the so-called perfect market was not and never was perfect; that perfectly competitive producers saw imperfection mainly on the other side of the market; that perfectly competitive producers tired of being squeezed price and income-wise by groups of input suppliers and output-buyers and that farmers were more than glad to shift their entrepreneurship to nonfarm firms since "open markets" were so much against them. Imperfect markets with integration are probably superior to imperfect markets with no coordination.

Experiences in the broiler industry during 1950 brought this fact out very vividly and signified the start of mass integration. Broiler growers had taken a terrible beating price-wise and income-wise during most of that year but feed dealers, hatcheries and processors were rolling in money because of their high margins and high turnover. Suddenly growers decided to quit taking the risks and almost as if in a combination declared they would never refill their houses. Overnight dealers started bargaining for these houses since their mills and plants had to operate. Guarantees and deals went out everywhere and the open-market-farmer-take-all-therisk was forever at an end in broilers. Many economists may have therefore mis-structured broiler integration. Integration happened because the open market was imperfect and did not cause the market to become imperfect.

Proceeding to more formal coordination where the terms "coordination" and "integration" are used interchangeably as they represent facets of the same process, horizontal coordination represents firms and/or units on one and the same level, and vertical coordination represents an association of two or more stages in the production-marketing process, and "circular" integration represents a simultaneous order of horizontal and vertical coordination.

# Nonintegration or Non-Coordination

This is the "norm" or benchmark whereby no formal or informal agreements relating to any aspect of the good in question are negotiated. This is indicative of our auction markets where sellers and buyers meet, of brokerage and sales agencies where goods may be handled with no advanced specifications between seller and buyer.

The advantages of nonintegration are that the grower can bargain for

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price at time of sale; can dispose of a good at his own choosing and on whichever market he desires; can appoint whomever he pleases as sales agent; can bargain for and procure inputs from anyone in producing

goods.

The disadvantages are that bargaining power may be lacking on day of sale; market may already be glutted by other producers who had made similar production decisions on basis of price behavior sometime in the past; collusion among buyers may disrupt market at time of sale and inputs for producing the good may be already committed to others or at least the best grade of inputs. Application of technology may be severely restrained because the operator cannot adequately measure the effect of this technology such as selling grade A large eggs on a current receipt market. In summarizing nonintegration, non-coordination does not make markets more perfect; coodination does not make them less perfect.

### Quasi-Integration

This term was coined by a graduate student at Louisiana University in 1952 to signify the coordinated relationships existing between and among firms, horizontally and/or vertically, but with entrepreneurship remaining in each respective firm. Admittedly, this covers a wide range of firm

activity short of absolute merger and consolidation.

The advantages of quasi-integration are that management is decentralized into more firms while at the same time affording advantages in certainty of supply, economies of operation and control over sales. It allows a considerable degree of independent managerial effort and does not necessitate changes in the corporate structure in order to do business. It is very flexible and adaptable to many varied situations, and for packers—for example—with high overhead and high labor costs and which can hardly afford to operate at less than full capacity, quasi-integration could help in supply stability.

The disadvantages are its very loose nature which makes dissolution and withdrawal relatively easy; short-term agreements usually lasting one-year hamper longer-range plant and equipment expansions; entrepreneurs are limited to exactly what the agreement stipulates—nothing more or less—and bargaining advantages may accure to the horizontally associated growers who may have similar economic demands on the supply or processing firm negotiating these agreements. This may be con-

versely an advantage to growers.

# Complete Integration

This has been the most confusing phase of economic integration and the most misunderstood. There are at least two methods by which complete integration may be achieved: (a) a firm absorbs or creates another only in their Pro

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unit, horizontally or vertically, but with corporate indentity residing in only one firm and (b) entrepreneurs create a new entity at another stage in the growing-marketing process but with all integrating units retaining their identity and primary function.

# Proprietary Integration

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This type of coordination accounts for the largest part of the economic integration in the South today in broilers, hatching eggs, table eggs and hogs. Basically, feed dealer firms and/or processing firms have coordinated forward and/or backward to gain control of another stage in the process. Most of these coordinations have included the grower or farmer who became a hired-hand of the combine and disappeared as an entrepreneur but remained as a laborer.

The advantages are obvious. Feed sales, chick sales and processing plants can be stabilized at a high level thus reducing fixed costs per unit; bargaining advantages with retail chain stores can be effected through large and stable volumes; growers' indecision can be eliminated and harnessed to the "team" thus increasing stability and harmony; growers' lack of alternatives in employing their labor on the farm can be utilized at a nominal wage rate representing, for example, only 10 per cent of broiler production costs and; application of technology can be swift and precise throughout the system.

Disadvantages are that the combine must commit vast amount of resources in fixed plant and equipment costs; large amounts of operating capital are required to finance all segments of the combine; superb management must be forthcoming in order to coordinate all operations; oligopolistic structure of the industry forces a constant evaluation of rivals' technical and price policies; waged growers may eventually associate with AFL-CIO or some other union and bargain collectively as may other employees of the combine.

# Cooperative Integration

Entrepreneurs, whether farmers or food store operators, may integrate horizontally and then vertically forwards and/or backwards to gain control of another stage in the production-marketing process. I. Emelianoff¹ pointed out that setting up a cooperative business is not setting-up another firm but merely extending the scope of the firm or firms doing the intergrating. This reasoning not only has a sound economic basis but is also consistent with the rulings of the Internal Revenue Service; interpretations of the Supreme Court and, last but not least, with the will and intents of the Congress.

<sup>&</sup>lt;sup>1</sup>I. Emelianoff, Economic Theory of Cooperation, Ann Arbor: Edwards Bros., 1942, pp. 58-59.

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The advantages are obvious. Farmers and others can achieve economies-to-scale in buying and selling yet control the combine; they can get a better economic measure of what proprietary firms are doing in the same or related fields; they can take better advantages of new technology and finance; and before vertically coordinating into milling and processing, they can gain experience in horizontal coordination through bargaining associations.

The disadvantages are of course, that large capital subscriptions are necessary for vertical coordinations. Loyalty and support of members is required along with superb management to guide and operate the cooperative. Often group interests have to prevail over the individuals' interest so that maximum benefits can accrue to all.

Empirical Observations in Coordinating Production and Marketing Quasi-Integration

(Observations applicable to the southern states and may or may not apply elsewhere.) Examples of quasi-integration in the South, or where two distinct entrepreneurs negotiate at one or more stages of the production-marketing process, have been: (1) Feed dealer and broiler grower negotiate an "open account" broiler program. (2) Broiler processor and broiler grower agree to scheduling of broilers one year in advance but with no income guarantees. (3) Vegetable grower and canner negotiate variety, management and delivery contract. (4) Dairymen negotiate with farmers to grow replacement heifers specifying breed, management program and age at delivery. (5) Egg breaker negotiates with hatching egg producers to deliver all cull hatching eggs year-round. (6) Pulp mill negotiates with timber owner to buy all timber available for cutting during next three to five years. (7) Beef cattle producer negotiates with feed lot operator to feed-out calves for certain period and for a certain fee. (8) Chain store agrees to buy table eggs year-round from growers but must meet certain grade standards, sizes, handling and delivery schedules. (9) Meat-packer agrees to purchase meat-type hogs from growers on a yearround basis with a \$1.00 per cwt. premium over standard hogs in a certain market. (10) Feed dealer agrees to buy started pullets from growers at \$1.85 each, strain-cross birds, 15-weeks of age, culled and on a year-round basis.

Predictions in relation to quasi-integration are that it will lose out in broilers, hatching eggs, turkeys, canned and frozen vegetables but will persist in hogs, sheep, table eggs, beef cattle and fresh vegetables. For the South, we shall see that grain growers (soybeans, oats, milo, corn) contract with local grain elevators so as to provide grain feed for the huge integrated programs in livestock and for foreign export to a lesser extent.

In turn, local elevators will contract with feed dealers engaged in this integration. Eventually, feed dealers will leave the national mills altogether and own their elevators and concentrate-grain mix programs. Dairymen will contract for more of their inputs such as concentrate feed, some roughage and replacement heifers. Hatching-egg producers will contract to produce the egg-type strain crosses and hybrids for the local franchised hatchery which is already quasi-integrated with national hatcheries. Feed lot operators will contract more with packers. Rice mills will contract more for rice acreage and sugar mills for sugar cane acreage. Food chains will expand their quasi-integration programs through private labeling. Fresh vegetable growers will contract for variety, volume and minimum prices with fresh produce agencies. Feed dealers will contract for volume and quality control in table eggs. Cattle producers will contract calves to meat packers who in turn will contract with feed lot operators or else feed their own.

# Complete Integration (Proprietary)

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Examples of complete integration or examples of a firm absorbing and/or creating another firm or entity horizontally and/or vertically, have been:

(1) broiler processor owning broiler-production units on wage contracts; (2) table egg dealer owning table egg flocks on wage contracts; (3) feed dealer owns broiler-production units on wage contracts; (4) cannery owns acreage and grows vegetables; (5) hatchery owns its breeder flocks; (6) dairy plant owns its dairy herds; (7) cotton ginner owns cotton acreage; (8) meat packers own feeder operations; (9) retail food chains own processing plants; (10) sugar mill owns cane acreage.

In general, complete integration through proprietary firms will gain in broilers, turkeys, hatching eggs, canned and frozen vegetables and some in table eggs and processed eggs. It may not lose out anywhere. It will gain some also in pork and other red meats. For the South, we shall see that feed dealers integrate egg dealerships and then integrate table egg production with efficiency clauses. All hatching eggs will be produced on a certain fee per dozen with efficiency clauses. Retail food chains will own much more of their facilities in packing. Canners will own more of their acreage and/or use wage contracts. Feed dealers will integrate further in hog, beef and lamb feeding and contract with packers. Meat-packers will also feed more and extend vertically into calf procurement and calf production. Feed dealers will develop pig hatcheries and started pullets for both table eggs and hatching egg production facilities on their own. Textile mills will integrate their buying into cotton areas. Integration in various by-products will develop fast such as in new poultry litter uses; egg

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shells; hatchery wastes; processing by-products, mostly under processor domination particularly in larger horizontal integrations. Broiler integration will change drastically by consolidating production units or further horizontal integration. There are too many small broiler integrators in the South; companies are anxious to combine four or five present smaller units into one large unit with professional management. Those smaller, idle broiler houses will be adapted swiftly to replacement heifers; pig parlors; small feed lots; table egg integration and/or hatching egg integration.

### Complete Integration (Cooperative)

Examples of complete integration, through co-ops or where farmers and others create another entity, horizontally or vertically as an adjunct to the farm or other entrepreneurship, are: (1) vegetable growers own the cannery and sales agency; (2) broiler growers own the processing plant and distributorship; (3) broiler growers own the feed mill, hatchery and breeder flocks; (4) pecan growers own the shelling plant and sales agency; (5) table egg producers own dealerships, in feed and egg handling; (6) dairymen process and retail milk; (7) livestock producers own the packing plant; (8) rice growers own the drying, milling and sales facilities; (9) farmers own input supply firms in fertilizer, petroleum, seed, feed and equipment; (10) cotton growers own gins and oil mills.

For the future of co-op integration in the South we see that more growers bargaining collectively or horizontal integration. Later, growers will own several more of the input and output stages of their business. Development of newer cooperative organizations will ensue such as water supply co-ops and district sanitation co-ops. Growers will extend raw sugar milling into sugar refining. Soybean growers will extend into oil mills as will cotton growers. Development of federal orders and marketing agreements in milk, vegetables and fruit will proceed fast by and through producer co-ops. Growers through co-ops will negotiate more favorably with co-op grocery chains and a strong business alliance thus created. Co-ops will work with other co-ops in REA, wholesaling, rural credit unions, etc., to coordinate their economic affairs. Co-ops will form new auxilliary service co-ops as in auditing, management consultant, research and engineering. Co-ops will form new credit co-ops to combat finance schemes of private integrators, or will ally more firmly with certain banks and PCA's to obtain a fuller time of credit.

In conclusion, many farmers have shifted from nonintegration, where they had poor bargaining strength as entrepreneurs, to quasi-integration where they had slightly more and finally to waged laborers for profit-type corporations where their bargaining strength is not much enhanced over quasi-integration. What is the next step? ocessor

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One, cooperative corporations can be resurrected in some cases where entrepreneurs can regain their former status. Two, collective bargaining unions can be formed to negotiate with integrators. Three, continue with the status quo of individual bargaining with the integrators. Or four, expect state and federal legislation relative to wages, hours and working conditions for waged contractors so that minimum wage payments plus other benefits are provided.

It would seem, however, that coordination under imperfect competition is preferred to uncoordination because it is better to work for an integrator combine on contract, where terms are discussed, rather than for openmarket operations where terms are not discussed but concluded impersonally through the price system.

Let us not forget that federal price supports have had, in effect, integrated the basic crops to the extent of some horizonal and vertical integration through producer referenda; acreage allotments and commodity credit storage operations. Thus, as under economic integration in broilers, the cotton grower knows that if he produces cotton to specification of middling one-inch he shall receive a certain guaranteed price, or more, if the free market provides it. His income is also guaranteed to the extent that if his allotment is placed in a Soil Bank, his income will be equal to what he could have netted per acre, on the average. This reminds one of the broiler contracts in the South where guaranteed prices were assured but if the price went higher, the grower shared the excess. We conclude that economic integration in livestock and in other nonsupported areas is much in response to the wide and sweeping price support programs afforded other commodity groups. We may have to learn to live with both economic integration and government price supports.

# DISCUSSION: ALTERNATIVE WAYS OF COORDINATING PRODUCTION AND MARKETING

GORDON W. SPRAGUE Land O'Lakes Creameries, Inc.

The word "coordinating" adds confusion because it is too inclusive. This is clear from Roy's definition, which requires so much space in a carefully prepared paper. The question is—will contract agriculture direct production in such a way as to better satisfy the quantity and the quality requirements of our national market?

The use of the broiler industry as a model gives cause for doubt. At the close of the war and immediately thereafter, the conversion of broiler feed to saleable live broilers was at the ratio of about 3.5 to 1. Prices to pro-

ducers were at about 28 to 32 cents per pound. The rate of output from production facilities was about 3 lots of broilers per year. More recently, the conversion rate approaches 2.2 to 1. The price to producers is about 10 cents per pound lower. The producer can now turn out about 4 lots per year at from 2 to 4 times as many broilers per lot.

Commercial broiler production has increased manyfold, but overnoon

duction has affected the industry only for very short periods.

Should we expect development of other farm enterprises according to the model of the broiler industry? Will the results be the same? Will the future in the broiler industry continue to be a model?

The high rate of turnover, four crops per year, is unlike any other farming venture which quickly comes to mind. Adjustments in output can be made quickly, but in the history of the industry to date, due to a strong growth potential, most adjustments have been upward. The industry has not yet reached operational maturity. Is this a suitable model for other

production and marketing enterprise?

Coordination by contract develops through financing and the preferred position for contracting producers. The well-financed producer with a contract gets a preferred relationship with reference to supplies and a limited franchise in the market. Producers without contracts occupy a secondary place. This is true because the contracting integrator will control the routes to market. He will have taken over the larger part of the risk. He will employ a staff of fieldmen to protect his contractual interests and responsibilities at the various points in the chain of production. Producer located close to processing plants will therefore receive a contracting advantage due to the lower cost of administration and of delivery of both products and supplies. Farmers living at a distance from the existing plants, or living beyond the economic range of activity of the supervising staff, will be penalized.

In general, it will be more desirable for the integrator to expand the volume in existing plants than to build new ones in new producing areas.

This notion of coordinating production carries with it the suggestion that the ideal of the free market is no longer useful. Are the agricultural economists ready to recommend the abandonment of free markets in the food industry while our contemporaries in the administration of antitust law work in the opposite direction?

Perhaps we have another model in the dairy industry where some markets have been controlled for about 20 years. The difference between the broiler industry and the dairy industry, particularly with reference to short-run changes, is very wide. With respect to the advantages to integrators and contracts, the organization for marketing milk is perhaps more effective. The dairy industry, under marketing orders, offers 20 years

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of history in an industry in which the fluid milk portion of the industry is strongly controlled while the remainder of the industry, though highly integrated, operates with markets relatively free.

Under the Marketing Agreement Act, the rights to buy and sell fluid milk are quite firmly held by selected individuals. These rights are protected by contract, pricing arrangements, sanitary requirements, state legislation, and the high cost of transporting milk. The net result of the several protective devices has left little doubt that the right to sell milk is controlled. The producers holding the market franchise also have pricing

MILK: AVERAGE PRICES PAID FOR MILK OF 3.5 PER CENT FAT CONTENT

Year	Milk price per hundred- weight paid by dealers for distribution in fluid form	Milk price per hundred- weight paid to producers for milk delivered at condenseries	Difference
	\$ per cwt	\$ per cwt	\$ per cwt
1937	2.68	1.57	1.11
1938	2.56	1.25	1.31
1939	2.45	1.24	1.21
1940	2.57	1.38	1.19
1941	2.79	1.81	0.98
1947	5.00	3.46	1.54
1948	5.54	3.90	1.64
1949	5.08	2.81	2.27
1950	4.86	2.87	1.99
1951	5.49	3.53	1.96
1952	5.76	3.74	2.02
1953	5.43	3.11	2.32
1954	5.15	2.81	2.34
1955	5.19	2.84	2.35
1956	5.34	2.94	2.42
1957	5.48	2.94	2.54

Note: This record shows prices, historically, over the 20-year period in which marketing agreements and state milk control reached the present state of development.

arrangements peculiar to their own market situation. Has this resulted in coordination?

This has not operated as a production control. Other dairymen, excluded from these higher-priced markets but apparently more efficient producers of milk, have used lower-priced outlets in the relatively free market and increased their production. The spread between the price for milk used for fluid distribution as milk and the price to farmers for milk used in condenseries has grown year by year, but the more efficient producers of low-priced milk have not retired.

From these data, it seems quite likely that both the consumer and those more efficient producers of milk for the low-priced markets have fared rather badly by comparison with producers who have shared in the benefits of a controlled market. This is particularly true if you accept the thesis

that relatively little of the increase in price spread since the war can be attributed to transportation cost.

Contract farming may develop along many lines in the years ahead. Several undesirable secondary results are likely to develop. For purposes of discussion, the following are suggested:

- (1) The farmer with the contract will become the best risk because he has a franchise in the best markets. Other farmers, regardless of efficiency, will be at a disadvantage in financing.
- (2) Contracts, for purposes of profit to the integrator, will be given to farmers located near processing plants. Nearness to plants reduces transportation costs, simplifies servicing of loans and production, and facilitates policing of other contract provisions such as purchase of supplies, place and time of sale. Efficiency in policing of contracts will supersede efficiency in production as a pricing consideration.

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- (3) Those farmers and competing areas at a disadvantage in financing and production service will sell in lower-priced, more competitive markets and tend to be frozen out of the total production pattern, regardless of efficiency.
- (4) As market relationships become integrated and closed, the opportunity for innovations and improvements through research will become more difficult, particularly if they threaten to make existing investment obsolete.

# DECISION-MAKING IN INTEGRATED PRODUCTION AND MARKETING SYSTEMS

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R. L. Kohls
Purdue University

In Handling this subject three major assumptions are made. First, the extension of the effective area of decision-making control and coordination is an acceptable simplified definition of vertical integration. Second, interest is not in vertical integration in general (since such a process is already widespread in much of American industry). Rather, interest is in the special case wherein an agricultural production activity (not necessarily a farm unit) is being brought together with some marketing or processing activities by an integrating process. And third, this integration of agricultural production is being accomplished in most instances through a system of contractual arrangement instead of through outright purchase.

Why such integration is taking place will not be discussed. Neither will the extent or nature of the integration effort in pulling together all the firms between the raw product and the consumer be discussed. Our questions are directed to cases where contractual farm production arrangements are in existence with other types of activities. Most attention will be narrowly directed to the arrangements beween the farm firm and other activities and to the impact on the farm firm itself.

Within these limitations the discussion will deal with three major questions. (1) What type and where will decisions be made in an integrated system? (2) Will the management answers to problems be different under integration? and (3) What becomes of entrepreneurial freedom of the farmer?

#### What Decision Will Be Made Where?

Obviously by definition, when the agricultural production activity is integrated with other activities, some decisions will be shifted from the farm manager to the party activating the process. In viewing the agricul-

¹It is freely acknowledged that many of the ideas and concepts concerning the organization and operation of the firm were stimulated by Wroe Alderson's Marketing Behavior and Executive Action, Homewood, Illinois: Richard Irwin, 1957 and those concerning freedom by Kenneth Boulding's Principles of Economic Policy, New York: Prentice-Hall, Inc., 1958, Chapters 1-6. Other helpful ideas were obtained from: A. R. Oxenfeld, Industrial Pricing and Marketing Practices, New York: Prentice-Hall, Inc., 1951, Joel Dean, Managerial Economics, New York: Prentice-Hall, Inc., 1951, and C. A. Hickman and M. H. Kuhn, Individuals, Groups and Economic Behavior, New York: Dryden Press, 1956.

tural production phase, the possible important decision areas under consideration here might be classified as follows:<sup>2</sup>

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(1) What to produce—from the viewpoint of the integrated effort "what" refers to quality and other physical aspects of the product. Whether to produce the product itself is a decision already made when the integration agreement was made. Whether to continue the agreement year-after-year of course becomes a decision for periodic reconsideration.

(2) How much to produce-the quantity problem.

(3) When to produce—the timing and coordination of the flow of the product.

(4) What methods will be used—the technological considerations of how the activity will be performed.

#### The Location of Decision Centers

In considering the "location" of decision centers it is helpful to consider any production process as an "upward" series of events and activities. The series starts with the arrangement and initiation of production of the raw product at the bottom and ends with the selling of an acceptable product to consumers at the top. This series of activities requires coordination and balance. In a series of independent firms, the manager of each unit adjusts his activities to the market expectations as he sees them. He leaves the problem of coordination among the units of the series to the market process and its resultant prices. When this series of activities operates within an integrated organization, coordination among the parts become a function of the management of the total organization. Just at what level in the series decisions will be made depends upon the nature of the problem itself.

Generally, decision activities may be put into two broad categoriesthe routinized or repeating type of decisions and the decisions dealing with strategic, non-repeating activities.

The routine decisions tend to make up what is commonly known as the administrative area. As such the locus of these activities will be kept as near the activity as possible. Under most circumstances, the "what kind of product" issues would remain relatively unchanged as long as the consumer preferences did not change sharply. The "what methods of production" issues would change mainly only as technological innovations arose. The factors affecting decisions in these two areas will probably remain relatively unchanged for substantial periods of time. Within these time

<sup>&</sup>lt;sup>2</sup> Certainly there are other types of decisions which must be made by the integrated firm. For example, there is the question of where geographically integration will take place. However, such discussion had best be left to others in this series of papers who are to deal with the aggregative dynamic effects of the integration process.

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periods, decisions on these problems can be largely routinized. These decision activities it would seem would be left largely at levels near the point of contact with the farm firm.

The decisions of "how much" and "when" are not of such a routine or repeating character. Each decision here must take account of the everchanging conditions of the market. They also involve the broader policy issues of flow and timing which affect the operation of all of the other units in the organizational series. Here it becomes very important to utilize the best analysis and experience available to consider both the external market and the internal relationships. It would seem that the locus of these strategic decisions must be moved "up" in the organization where appropriate staff intelligence and over-all policy coordination can be better acquired.

In practice, of course, this sharp classification of decisions will not hold. Periodically problems arising from major shifts in the factors affecting what and how to produce would be sent up to higher staff levels for action. Or, if market conditions stabilized, output decisions might be quite routinely handled.

In the early phases of integration efforts, there may be attempts to leave all possible decision making in the hands of the first unit contacting the farm, such as the local supplier or local financier. However, in any substantial integration effort it is likely that the strategic type of decisions will gravitate upwards in the organization. After all, managerial experience and ability and market intelligence are scarce factors. These factors are not necessarily equally available at all levels and theoretically at least should gravitate upward in an organizational hierarchy. The very nature of integration is supposed to permit, through the separation of routine and non-routine decisions, a conservation and better use of these scarce resources.

# What Decision Areas Will Be Transferred?

Once conditions are present to make integration efforts feasible, the tendency will be to lift as much decision making as possible from the farm production unit up into the organizational structure. Early experimental efforts may try to lift only a few important areas and leave the remainder with the original farm firm management. However, the push for the closure of a system of serial activities is strong. The power to act is a goal of rational management. A series of activities, part of whose direction is coordinated and part of which is left free to the sub-units, limits this power. Partial control may well increase the risks of the integrating management without its realizing the offsetting benefits. Also, the larger an organization, the more difficult it becomes to maintain the very important attribute of being adaptable to direction. The more complete the closure of the

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activity serial, the greater the ability of management to secure rapid and effective response to its directions. This is not to say whether larger or ganizational aggregates are more adaptable to changing external conditions. They may or may not be.

If the foregoing are valid, some answers to the question of what decisions will be made where can be made. Firstly, routinizable decisions dealing largely with the what and how to produce will be administered by agencies close to the farm firms themselves; the more strategic, policy decisions involving volume and time will gravitate upward in the organizational hierarchy to the more important decision centers. Secondly, passing time, in situations where integration is possible, will see the bringing of more and more of the decision making processes under the integrator's control. If integration were being accomplished by outright ownership, many of these considerations would not be pertinent. However, we are dealing here with a contractual development by which property rights and control are broken off piece-by-piece. Both of the above conclusions refer to tendencies over time which will develop under the latter process.

It may be useful to point out here that it seems very unlikely that realistic answers to this question of who is really making decisions can be ascertained through the usual survey techniques of the producers involved. In a recent very interesting study both dealers and growers were asked which party was primarily responsible for making decisions. The answers showed that in many instances both parties thought they made the decisions. This may be indicative of the confusion and transition which would exist in the early phases of contractual integration. However, such answers could also be obtained in a well-developed, well-functioning highly decision-centralized organization. Any successful integrator must persuade his producers that they are part of the total group and are participating in its operation. The backbone of stable and successful contractual integration is the development of a community of interests and experiences by all involved parties.

# Will Decisions Be Made Differently?

Will the answer to the same question be the same by the decision-maker of an integrated organization as by the decision-makers of small independent units? Here analysis must move up from the production economics of the small firm assuming near pure competition of factor and product markets to one of larger units operating in a more imperfect situation. Here also the nagging fear held by many friends of the agricultural producer must be faced—that integrating organizations will take advantage of their increased power to exploit the producer.

<sup>&</sup>lt;sup>3</sup> F. D. Hansing, "Financing the Production of Broilers in Lower Delaware," Delaware Experiment Station Bulletin 322, October, 1957.

Mehren in a recent paper after considerable exploration concluded, "However, there appears to be no fundamental change in the making of a market or the making of a price which reflects the making of the market (which can be attributed to the integration process).—In short, it appears to me that the same major factors are involved in the making of a market as always before." On the other hand, Seaver in a recent paper stated, "Achieving such organizational innovations invariably involves some degree of control. . . . And let's not be naive enough to think that this control could not lead ultimately to large degrees of monopoly." Which of these points of view you agree with does not answer the question raised here, where interest is in the decisions made concerning specific problems at a specific point in time. What the end aggregative results of these managerial decisions will be in the long run is a problem to be wrestled with separately.

### A Difference in Goals?

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Profit maximization is the assumed goal of the farm firms. Much of the rationale of production economics is built around this goal as the major dominating motive of managers. How valid is this as the motivating force for larger business aggregates? Will these latter always act to extract the highest possible profits? Much of the current literature is seriously questioning profit-maximization as the dominant motivating force in the management of large businesses.

Several restraints upon large businesses are present to act against seeking the most possible profits. First and most obvious is the legal structure of our anti-trust laws. But probably a still more powerful restraint is the potential ire of the voting public and their investigating governmental representatives. (Big business has observed that public dog-houses are easily built, but exasperatingly difficult to demolish.) Less than maximum profits also may be settled for to discourage potential competitors and to maintain good will and working relationships of participating groups. (Alderson has discussed the necessity of "competing for cooperation" which would seem to have real implications in a contractual integration scheme.) To these must be added the known force—but of unknown power—of the business ethic to realize a "fair return." There are indications that the idea of fair return is a real figure and that returns can either be too great or too little when compared with it.

To this list of profit restraints must be added what certainly are known

<sup>&</sup>lt;sup>4</sup>G. L. Mehren, "How is the Market Made in Integrated Industries?" a paper given at the National Institute of Animal Agriculture, Purdue University, April 21, 1958.

<sup>&</sup>lt;sup>3</sup> S. K. Seaver, "Adopting Integration to the Independent Connecticut Poultry Industry," a paper given at the Connecticut Poultry Association Meeting, December 3, 1957.

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to be real forces in modern corporate management. Firms must act either to maintain their size and position or, what is more important, to grow and expand. All of these were neatly summed up by a grocery chain manager speaking of his colleagues when he said, "In general, they don't, I believe, care too much what they pay for any product. They are interested in seeing that: (1) no competitors pay less, (2) the gross margin percentage is right, and (3) the product sells. . . . Americans are production and sales minded. The little ones always want to be big."6

Most authorities apparently agree that profit maximizatian as the goal of large modern firms is satisfactory only if the idea of profits is very broadly construed in the very long run. Many of us will say that this conclusion is nothing different from what economics has acknowledged to be true as firms move from the near perfect competitive over to more imperfect and monopolistic situations and as the time period is shifted from the very short to the very long run. This is probably true. But for those of us who have usually been concerned with the farm or other very small businesses, it is one of the major changes which faces us in this integration development.

### The Many-Sidedness of Larger Organizations

In analyzing the decisions of larger integrated systems it is helpful to think of these systems as being made up of three sub-systems of behavior  ${\bf p}$ 

and operation.

The first is an input-output system in which actions are taken to organize inputs in order to realize a desired level of outputs. Here the issues evolving around technological efficiency must be weighed and settled. It is likely that decisions involving changing technology and methods may be made and implemented more swiftly and completely in the larger organizations. The bottle-necks often existing in smaller firms arising from lack or difficulty of financing, low levels of managerial ability, and ignorance of available technology may not exist to the same extent as the potentially greater resources of larger firms are made available. And as mentioned earlier, in the closed system once the decision is made, mechanics are available to see that it is carried out. Apart from the potentiality of relieving such bottle-necks, it would seem that the decision answer to input-output efficiency problems would not be greatly different in the integrated system compared with a system of independent units.

The second sub-system is a *power system* in which actions are taken to either enhance the status position of the firm or at least protect it from

<sup>&</sup>lt;sup>6</sup> C. W. Sadd, "Impact of Integration on Agricultural Product Marketing," a paper given at the National Institute of Animal Agriculture, Purdue University, April 21, 1958.

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deterioration. Though even small firms are not free from power considerations, certainly this issue must receive more attention from the larger firms. Every firm has a reputation and position of some type to consider. The impact of today's actions upon tomorrow's size, relative position in the market and relations both internal and external to the firm must be considered. It is from the increased importance of this behavioral subsystem that many of the really new forces affecting decision-making will flow.

Let us explore how some of these factors might influence the decision of what quantity of production should be forthcoming in the next product period. Assume that the supply-demand expectations lead to the conclusion that production should be reduced sharply in order to make operations for the period profitable. Before such action is taken some other issues must be considered in the decision such as the following:

a) If the cut-back is ordered will competitors step in and pick off the firm's discarded producers so that in a future period the firm's share of the market will be substantially reduced?

b) Even if competitors do not immediately step in, what will this action do to the firm's relationship and reputation with growers? It does not own them, but contracts for their cooperation. And even if it does not lose them, the development of an organization which might use countervailing bargaining power with all of its managerial headaches is a real possibility.

c) Will such an action seriously jeopardize the firm's public relations with possible legal or governmental repercussions? After all, no firm involved in agricultural integration can politically afford to overtly offend its agricultural participants. When nonfarm firms integrate themselves with agricultural production, they "integrate" themselves politically with the farmers' problems whether they like it or not.

Just how such considerations will affect the final decision to such a problem as posed above probably cannot be answered by generalization. However, it is enough to insist that they will be a part of such decisions.

The third major sub-system is a communication system in which actions must be taken to see that information is channelled into the pertinent decision center and that its resultant directions are received, understood and carried out on schedule. Many believe that the possibility of better timed and coordinated product flow is the real consideration pushing for integration. In fact, the above question of how much to reduce production in advance to its taking place would not be an issue to the independent marketing firm. They would simply handle the production results of the decision of the multitudinous small farm units.

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make the satisfactory operation of the communication system more important. The larger, more complex and internally complete an organization becomes, the bigger becomes the problem of coordinating the parts, Issues of organization must be continually struggled with. With integration management must undertake the formulation of knowledge and expectations of the sub-units which previously gained them from the market it. self. All must hold expectations of benefit. Farmers, feed dealers, processors and others must each believe in the benefits of being coordinated especially if the coordination is of a contractual nature. Part of this belief of course, stems from the current and past remuneration received. How. ever, part of such expectations also stems from the management's efforts in creating expectations. To do this requires that communications avenues be operative both "up-and-down." The top cannot make decisions without first considering the state of knowledge-or ignorance-of the lower units. For example, in the hypothetical problem of how much to reduce output posed above, the decision might be to first hold a series of meetings with growers and others concerning the state of the expected market. Two results might come from such efforts. First, expectations of the sub-agencies might be created which are more in line with the thinking of the management. And secondly, management after feeling the pulse of its organization, might better be able to evaluate the internal results of alternative actions.

In conclusion it would appear that certainly the process of making decisions in an integrated system may be changed somewhat. And for certain types of problems, the answers rendered may differ. Agreement here is with those who believe that it is not in the technological aspects of the input-output system where the most marked difference will occur. Rather, the most differences will occur in those areas of the power system where the imperfectly competitive situation and the longer-run issues must be faced. The whole organization—not the individual parts—becomes the pertinent unit for many considerations. Just as in the management of the farm itself, certain phases may be operated in light of their contribution to the whole rather than as independent enterprises. Finally, though not rigorously treated here, there are factors which will act to police any tendency toward excessive economic exploitation of the contractual subunits of an integrated organization.

# What of Entrepreneurial Freedom of The Farmer?

This is the really emotion-packed issue involved in any integration discussion. At a recent conference an intelligent and successful Iowa farmer opened his talk on the impact of the integration development with the statement, "However, I do believe that now, more than at any other time

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in history, we (the American farmers) must constantly be on guard lest we trade our stake in agriculture for a 'mess of pottage'."

Certainly, this farmer states the fears of many public spokesmen for agriculture. However, just how the rank and file operators of farms feel is not factually known. The rapid acceptance of contractual operations in many wide-spread enterprises under a wide range of conditions indicates considerable open-mindedness as to what is being lost and what is being gained.

It can be positively stated that the development of a hierarchy (and integration certainly does this) affects freedom in some manner. Boulding expresses this well in what he calls the principle of exclusion—no two people can occupy exactly the same position at the same time. One either exercises managerial control over a specific problem or he does not. This, of course, as has been noted earlier, does not preclude the possibility that a well run integrated system might not result in one's thinking that he is bossing himself.

# Freedom and Property Rights Are Complex Concepts

Boulding's insistance that freedom is a many dimensioned proposition is a very helpful concept. First there is the ultimate boundary of freedom that is laid down by what is physically—and perhaps it should be added mentally—possible. No one considers his current inability to travel to the moon a very serious limitation of his freedom. Such inability will become a freedom limitation only after such travel is within the range of power to do so. This large area is next reduced by what is legally and socially permissive. One might have the power to take his neighbor's property by force, but both the laws of the land and the social mores of a Christian society prevent him from doing it. This somewhat smaller freedom area is then further restricted by what is economically possible. It is within this final circumvened area where the net freedom area lies. A very poor tarmer may have the physical and mental means to leave the farm and go to the city. Legally there are no restrictions and society generally would consider such a move highly desirable. But economically the farmer does not have the necessary means to make the move. Under these circumstances what is the realistic area of his freedom?

Similarly the concept of property rights is multi-sided. The entrepreneur's property rights are never absolute in any organized society. Both government and society circumscribe what is meant by individual property rights. Property rights are both physical and abstract. One may own the physical property of a house and sell the right for temporary use

<sup>&</sup>lt;sup>7</sup> N. A. Wilson, "How Does Integration Affect the Farmer" a paper given at the National Institute of Animal Agriculture, Purdue University, April 21, 1958.

by renting it. Currently a farmer may cwn the land to grow wheat, but in many cases this property right is incomplete without a proper  $q_{0001}$ 

This multi-sided approach to freedom and property is particularly valuable, since the integration which is really under discussion is not an outright purchase of all of the property rights, but rather a contractual exchange of certain portions of these freedoms and property rights.

When a farmer enters into a contractual integration arrangement in which he certainly surrenders some of his managerial and property rights, is the effect on the particular farmer's freedom a net loss or gain? The challenge here is to consider freedom in its full dimensions and to make sure something is not being treated as an end in itself which in reality is a means to an end. Is individual farm entrepreneurship an end or is it the means to an end? Is being "one's own boss" an end in itself—or a means for obtaining an end?

Freedom realistically considered consists of those things a person could do if he wanted. Under the system of family farms, whether owner or tenant operated, the farmer must be the manager. Does every person born on the farm have the capabilities (and desires) to be a full entrepreneur? Or are there some born on the rural side of the fence who both desire, and will be economically better off, working for someone else? For the urban sections of the society this question is not seriously considered anymore. There are opportunities in urban society for a man to make real choices as to the area of freedom he desires. Some desire the right to be their own boss even at the sharp expense of economic freedom—note the owner-operator of the small corner grocery store. Others desire to trade the entrepreneurial freedoms for greater economic freedom—note the hired manager of the corporate chain store. Still others attempt to compromise by giving up some entrepreneurial prerogatives—note the grocery operator who contractually participates in a voluntary chain organization.

# Freedom Result Depends Upon Alternative Structure

One could take the position that the development under discussion actually might enlarge the freedom area of agricultural operators by giving them additional choices as to how they shall organize their property, labor, and management potentials. The important conclusion here seems to be, as in all other economic matters, that the power of choice among available alternatives must be jealously guarded. This power of choice must be preserved in fact and not just in name. If integration becomes an additional road, then tomorrow's agriculture will be made up of people who have an increased freedom as to how to arrange their own economic lives. The Iowa farmer referred to earlier can go his own way; the individual who was born to the farm, but did not desire all the managerial head-aches, can go his.

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If individuals are forced to go one way or another because of the lack of real effective power to choose among alternatives, then there is a real threat to freedom. This is true whether the man is a farmer or a city dweller. Any substantial change in economic institutions raises such restrictions as a potential threat. The industrial revolution did. The advent of the corporation did. The development of agricultural integration will also raise the threat. But society has not rejected change because of threats. Rather it has attempted to police these changes into desirable directions. Similarly, integration must be accepted as a change whose impact upon the alternative structure must be watched closely.

# A Concluding Thought

The three questions raised were answered to some extent in the previous discussion and a recapitulation will not be done. Such questions do present a real challenge to agricultural economists. They unceremoniously push us out of our relatively safe little analytical ponds of small firm production economics and traditional marketing and price analysis and toss us into the wild and turbulent sea of the various degrees of imperfect competition of larger operating aggregates. The gap between the economics of agriculture and that of non agriculture is narrowed one step more. Such organizational dynamics also forces attention to a relatively neglected area of analysis—whether certain institutions are important in and of themselves, or whether they are simply the best currently available means to a desired end.

# DISCUSSION: DECISION-MAKING IN INTEGRATED PRODUCTION AND MARKETING SYSTEMS

WILLIAM E. FOLZ University of Idaho

While I agree generally with Kohls, it is difficult to recall anything specific which he covered in the paper. This is not necessarily a criticism of Kohls or of his paper. It merely emphasizes the point that it is almost impossible to say anything specific about a subject as general as managerial decision-making.

Perhaps a discussion of the currently popular topic of the extent to which integrated firms will take managerial decisions from the farmers and put them in the hands of business men was called for. Such a discussion would have as its objective the attainment of a better basis for decision-making on the part of economists. It would assist them to determine the extent to which agricultural welfare is being enhanced by the trend towards integration. If this is the objective, Kohls' paper falls short of the goal.

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Part of the difficulty in making the paper meaningful in this regard is due to the limitation of the area of discussion. Kohls assumed that integration had occurred already in order to confine his discussion to decision-making within the framework of existing integrated firms. He states: "Why such integration is taking place will not be discussed." It is my contention that the extent to which managerial decisions will continue to reside with the farmer or will be taken over by others will be inextricably bound to the reason for integration or contracting in the first instance.

If the purpose of contracting is merely to assure the processor of a supply of the commodity, the farmer may find that he has more rather than less managerial decisions to make. He must decide each year whether he will contract his acreage or sell at the price prevailing after the crop is harvested. In this case contract farming is no more limiting on the farmer's decision than is the existence of a futures market for his product. Even if the contractor specifies quite meticulously the product to be grown and the quality standards of the final product, no appreciable limitation to the farmer's managerial decisions will be experienced. As long as the farmer has the alternative either of selling in the market or of growing other crops, his willingness to enter into the contract can be interpreted as the attainment of a higher utility surface on his part.

The situation is considerably different when the farmer enters into contracts in which his investments and labor become specific. In the case of broilers, when the farmer supplies only the brood houses and his labor, his managerial decisions, once the contract is entered into, become seriously restricted. The conditions under which he works and produces approximate more closely those encountered by the workman on an assembly line than those faced by an entrepreneur. Somewhere between these two models decision-making in integrated firms will rest, depending upon the nature of the problems which the contractors are seeking to solve through integration. Entrepreneurship will be most completely retained by the farmer if the contract is for a commodity which requires little specialized skills or capital and when the producer can shift to other markets or other crops with ease. Entrepreneurship will tend to move into the hands of the business man off the farm most completely when the products contracted for resemble manufactured commodities; i.e., when they require specific raw materials and specific production processes, and when the end product is different from the same commodity produced by other methods. These two models describe the extremes in decision-making; most cases will fall in between. No advantage will be gained here by trying to identify these in-between cases. One can readily do it for himself. The problem itself becomes more or less significant in relation to the extent to which the individual cases in the future approach the former extreme or the latter.

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One point should be mentioned with respect to the latter extreme, that of decision-making completely removed from the farmer. The contractor must anticipate some economic advantage from contracting, since he usually has the alternative of producing himself. In broiler production, for example, what is to prevent the feed dealer or the processor from raising his own broilers if it is cheaper for him to do so? The answer must be either that there are some important entrepreneurial functions that remain with the producer which he can perform more cheaply than can the contractor, or else that the producer is performing some functions of other factors more cheaply. The farmer may be assuming some of the risks of loss, or he may be making some of the routine managerial decisions which would be too costly for the contractor to make, such as decisions relating to care of the chicks or repairs to the brood houses. He may be supplying the land and capital more economically than the contractor can secure it, or he may be taking a lower labor return than the market could command for labor of that quality.

The argument that decision-making in integrated firms may involve different goals, less emphasis on profit maximization is not impressive. The fact that the integrated organization fears anti-trust prosecution, or that it is sensitive to public opinion does not deny profit maximization. It merely means that profit maximization cannot be confined to decisions dictated by linear programming or synthetic models. However, the farmer's economic position will be precarious if his only protection against exploitation by the integrated firm is the firm's desire to put other goals ahead of profit maximization.

In evaluating integration and its effect on farmer decision-making as it contributes to or detracts from agricultural welfare, the same sets of paradoxes that have always been inherent in this subject must be faced. Economists probably have no way of knowing whether or not social utility is increased if farmers make slightly more money and have somewhat more stability of income, if these objectives are secured at the expense of reducing the farmer to the status of a hired laborer in industry. It is assumed, of course, that his income will be higher and more stable. However, there is the possibility that as integration and contracting proceed, incomes may be lower and loss stable. Under these conditions the problem is one that can readily be evaluated from a social point of view. We know from experience that rural slums and rural poverty are harder to combat than slums and poverty in the cities. For one thing, alternative employment opportunities are not as abundant. Under such conditions the farmer will have lost his freedom of decision-making and will have gained nothing in return. His plight may go unheeded by both economists and statesmen. It may require another Thomas Hood to write the rural counterpart of "The Song of the Shirt."

#### IMPACTS OF VERTICAL INTEGRATION ON OUTPUT PRICE AND INDUSTRY STRUCTURE\*

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J. A. SEAGRAVES AND C. E. BISHOP North Carolina State College

The concept of vertical integration is relatively new and it is not uniquely defined. It now appears that many laymen think of vertical integration as the production of items with a specific buyer in mind. As such it represents new efficiency in the coordination of firms, especially in agriculture, and as such it has caused undue concern by some people over the future of the family farm. We will discuss two widely different definitions of integration and their causes before discussing some effects of integration.

### Nature and Extent of Integration

#### Definitions:

A good deal of the controversy with respect to vertical integration has been a matter of definitions. The definition used makes a difference in the extent of integration, in the analysis of causes and effects of integration, and in conclusions about its future course and its effects on our social system.

Some economists are inclined toward a very narrow definition of vertical integration in which stages of production are "united in respect to ownership." Those using this definition are usually concerned with questions of market control, the establishment of monopoly, and the breaking up of monopoly through vertical integration. It might seem that ownership as a category is subject to exact definition in empirical work. Actually, there are many degrees of ownership and ownership is often quite removed from management. For purposes of discussion we narrowly define "owner integration" as the joining of two or more firms in the complete ownership of one firm. The definition applies to horizontal as well as vertical integration.

Other economists focus their attention on decision-making and the allocation of resources, regardless of ownership.<sup>2</sup> These economists view

Ontribution from the Department of Agricultural Economics, North Carolina Agricultural Experiment Station, Raleigh, North Carolina. Published with the approval of the Director of Research as Paper 949 of the Journal Series.

<sup>&</sup>lt;sup>1</sup> Stanley K. Seaver, "An Appraisal of Vertical Integration in the Broiler Industry," Journal of Farm Economics, December, 1957, pp. 1487-1497. Seaver quotes the definition of Frank Fetter from "Relative Efficiency of Large, Medium-Sized and Small Business," Investigation of Concentration of Economic Power, T.N.E.C. Monograph No. 13, Appendix D., p. 403.

<sup>&</sup>lt;sup>2</sup> See for example, William F. Mueller and Norman R. Collins, "Integration of Production, Processing and Marketing," *Journal of Farm Economics*, December, 1957,

vertical integration as a means of linking together, or coordinating, decisions of firms in two or more stages of the marketing and production processes. Coordinated decision-making by firms through contract or agreement is called "decision-integration" in this paper. Note that "owner integration" is a special case of "decision-integration" since scheduling and decision-making are coordinated under ownership.

#### Extent of Integration in North Carolina Broiler Production

The difference in the extent of integration under our two definitions is reflected in data on North Carolina broiler production in Tables 1 and 2. Production arrangements are classified by the degree of control the feed

Table 1. Extent of Integration Between Feed Dealers and Growers in North Carolina Broiler Production

	Broilers on feed in N. C. May, 1958		
Nature of integration or financing of growing stage	Number (000)	Per cent	
Grown by feed dealers in their own broiler houses	1,244	4.06	
Contracted out by feed dealers, not grown in own houses	26,908	87.88	
Scheduled by feed dealers, open account basis	1,470	4.80	
Scheduled by feed dealer, cash basis	998	3.26	
TOTAL	30,620	100.00	

dealer has over the growing stage in Table 1. "Owner integrated" birds are those for which the feed dealer owns the broiler house and other capital items, and, therefore, has long-run control over his market and output. In a strict sense then, only 4 per cent of the birds are grown on this basis.

Of the broilers in North Carolina 88 per cent are grown on a contract basis. The contracts are of a "guarantee" or "feed efficiency" type. Ownership of the broilers resides with the feed dealer. The growers can, and do, change feed dealers.

Almost 5 per cent of the broilers are grown on an "open account" basis. The feed dealer furnishes chicks and feed on credit and sometimes retains title to the birds. The grower often has a right to sell the broilers when and where he pleases, yet this right is rarely exercised. Three per cent of the broilers are grown on a cash basis; however, even here feed dealers

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pp. 1471-1486. See also, Robert L. Mighell, "Vertical Integration and Farm Management," Journal of Farm Economics, December, 1957, pp. 1666-1669, and Emery N. Castle, "Vertical Integration and Farm Management Research," Journal of Farm Economics, May, 1958, pp. 434-439.

normally schedule sale of the broilers for the farmer. If decision-integration includes the scheduling of output then virtually all the broilers produced commercially in North Carolina are vertically integrated.

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Integration between segments of the broiler industry other than growing is summarized in Table 2. The separate segments of the industry treated are hatching, feed manufacturing, feed retailing, live hauling, and processing. The degree of integration by ownership is indicated by the number of firms that combine ownership of two or more segments. A broad definition of ownership was used in tabulating these data such that partial ownership of one firm by another is included. Integration is often achieved by small exchange of stock between vertically associated corporations. Hatcheryman A may own part of feed dealer B, and B part

Table 2. Extent of Integration of North Carolina Broiler Production among Segments of the Industry Other than Growing

Number of comments of builty	Integrated by part ownership		Integrated by scheduling	
Number of segments of broiler industry (other than growing) integrated	No. firms	Av. size (000) birds	No. firms	Av. size (000) birds
1	13	190	0	0
2	39	250	2	112
3	17	556	3	877
4	1	480	17	305
5	5	903	54	375

of A, while feed dealer B owns part of processor C and C part of B. These three firms would be listed as one owner integrated firm of three segments in Table 2. Thirty-nine of the firms contacted combined two segments, 17 combined three segments, and five firms combined all five segments of the industry. There is a distinct increase in the number of broilers on feed per firm as the number of segments of the industry owned increases.

Formal contracts are rarely used among industry segments. The segments usually schedule work with one another through verbal booking agreements. Decision-integration is broadly enough defined to include this type of scheduling. Out of 76 firms studied 54 are completely integrated and 17 firms are only one step from being completely integrated.

Different definitions of integration do lead to quite different conclusions about the significance of it. Decision-integration is virtually complete in the growing stage of broiler production in North Carolina, and is almost complete in the five stages besides growing. The effects of decision-integration on efficiency, progress and competition in the broiler industry are of vital interest as a similar pattern seems likely in the marketing and production of many agricultural commodities. In contrast, complete

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ownership of vertically associated firms is of relatively little significance or interest.

# Causes of Vertically Integrated Agriculture

Before analyzing the effects of vertical integration upon output and industry structure, we must agree on the causes of vertical integration. One of the major reasons for vertically integrating business has been to enable the owner to gain increased control over the price of his product or the prices of inputs purchased. This motive has been especially important where vertical integration has developed on an ownership basis.

When a firm can realize greater profits by expanding vertically than horizontally it will be inclined to do so. Such profits would normally exist when the segment of industry to be integrated is either monopolistic, inefficient, or unreliable. There are many cases in which agricultural firms have expanded vertically for one of the above reasons.

Owner integration also is used to establish and protect monopolies. It is doubtful, however, if the existence of, or the formation of, monopolies has been a primary factor in the development of ownership integration in agriculture.

Decision-integration is much more important than ownership integration in agriculture. In the decisions type of integration, ownership is not necessarily passed from one decision-making firm to another. The essential element is that decisions (especially output decisions) of two or more units are coordinated through contracts or agreements. In order to understand the causes of decision-integration in agriculture we must have some appreciation for developments that have taken place in the retailing and processing of farm products.

During the last decade, the number and the sales of supermarkets have expanded at a phenomenal rate in the United States. These stores market large quantities of agricultural products in fairly stable volumes over time. They also require products of uniform quality. M. J. Thomas, agricultural counsel for the Kroger company, in discussing vertical integration, recently pointed out some of the problems that face the modern supermarket.

"As a food retailer, our job is to sell food. We believe we are specialists in this field. But to sell food and provide values, we must have products available in quantity, of uniform quality, and from a dependable source of supply. This is the only way, we can satisfy our boss, Mrs. Consumer. When one of these three prime requirements is not met, we think of integrating our operations." 3

<sup>&</sup>lt;sup>a</sup>M. J. Thomas, "Mass Merchandising Helped Integration Develop," paper presented at the Eighth Annual Meeting of the National Institute of Animal Agriculture held at Purdue University, April 20-22, 1958, published in "Impact of Integration" prepared by American Feed Manufacturers Association, 53 W. Jackson, Chicago, Ill., May 1958, p. 20.

Thomas may have added that the Kroger company needs quantity, quality and dependable supply at the *lowest possible* price. Competition among stores in price as well as quality has forced new efficiency, espe-

cially in coordination, right back to the farm.

It is often more difficult to standardize the quality of agricultural products than nonagricultural products. Nevertheless, the housewife, in making purchases, expects to receive products of uniform quality. The necessity of obtaining products of uniform internal quality has made it necessary to specify certain production practices at the farm level. The demand of supermarkets for large volumes of products of uniform quality from dependable suppliers has forced coordination or integration of decisions from retail market outlets to farmer producers.

The complexity of the modern market economy has placed greater emphasis upon coordination and control. Efficient operation of the economic system requires transmission to relevant decision-making units of information regarding prices, technology, and product and input flows. In the past we have relied heavily upon prices to filter the wishes of consumers back to farmers. This means of transmitting information inherently contains costly lags. The information transmitted to producers concerns consumer decisions at a particular point in time. After eventually receiving this information producers must make production plans consistent with the information.

As the economy has become more complex it has become apparent that gains could be realized from a smoother flow of information from consumers to producers. Producers' decisions could conform more closely to the wishes of consumers if producers have information at the time production decisions are made concerning the amounts and kinds of products wanted by consumers at the time the product will be ready for sale.

Basic changes that have taken place in techniques of production and processing of agricultural products also have encouraged integration. Agriculture is being rapidly transformed from a business based on at to a business based on science. In their attempts to increase efficiency, producers have been quick to adopt innovations in agricultural produc-

tion and processing.

The adoption of many scientific advancements requires investments of substantial quantities of capital in specialized equipment. Often it is not profitable to adopt new techniques and invest large sums in specialized equipment, unless output is expanded. For this reason, economies of size in a particular process such as egg grading may force it off the farm and into a central plant. Many farmers find that they can have higher profits by concentrating on the performance of a few jobs. Capital shortages also prevent the individual farm operator from performing all of the jobs

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involved. Consequently, specialization has developed in production and in processing of agricultural products on a scale never before witnessed in this country.

As producers have tended to specialize in the performance of relatively small jobs, the need for coordination of decisions of producers has increased. Individual decision makers now control relatively small segments of the total production and marketing. Because of this segmentation of control the possibility of uncertainty has increased compared with that which existed when one individual controlled production and marketing decisions at all levels. Through specialization, interdependence among decision-making units is increased. The profits of firms at each stage depend upon the decisions made by firms at each other stage in the production and marketing process. Mass production techniques cannot be employed effectively without a fairly uniform flow of raw materials to processing plants. Supplies must be predetermined and deliveries scheduled as needed for efficient operations. It has become necessary, therefore, for persons making decisions at one stage in production and marketing to have information with regard to the decisions made by others at earlier stages.

Decision-integration also is associated with imperfections in capital markets in agriculture. Expensive innovations coupled with constant pressure for adjustment and efficiency have created a need for additional investment. Decision-integration has made it possible for farmers to combine their resources with resources owned by others and thereby to obtain capital needed for farm adjustments at reasonably low risks.

In summary, there appear to be two basic factors leading to the development of decision-integration in agricultural production. They are:

(1) The demand of modern retailers for larger and steady volumes of uniform and high quality products at the lowest possible price.

(2) The greater specialization that has resulted from size-increasing innovations in the production and marketing of farm products. Both of these factors call for more efficient coordination of the production processes between the grower and the consumer.

# Effect of Vertical Integration on Output of Firms

In a competitive or a monopolistic industry the effects of changes in economic conditions upon output of a firm may be analyzed in terms of the effects upon individual cost and revenue functions of firms. Shifts in cost and revenue have less predictable effects upon output under conditions of monopolistic competition or bilateral monopoly. We will ignore the problems of the latter here and think in terms of a simplified model. Factors associated with integration which increase revenue or decrease

cost will be considered as providing an incentive to increase output, and vice versa. The framework within which we will discuss the relationship of integration to the output of firms is sketched in Figure 1. The conditions that cause integration affect cost and revenue functions. Three factors that result from better coordination also affect output. These are: risk reduction, better resource allocation, and more rapid technological advance.

Specification of uniform quality by retail outlets should increase costs per unit due to the grading costs and the losses of rejected items. At the same time, revenues should be increased. The effect upon output of firms is indeterminant.

Constant volume applies both seasonally and over time. More even seasonal production would be cost and revenue increasing in most cases

FIGURE 1. MODEL FOR DISCUSSING RELATIONSHIP OF INTEGRATION TO OUTPUT

Basic forces	Factors creating demand for better coordination	Results of coordi- nation that increase output per firm
Competitive supermarkets-	Uniform quality Constant volume →Large volume	Risk reduction  ✓ Risk reduction  → Better resource allocation
Technological- advance	→Specialization	More rapid innovation

with the effect on output indeterminant. If a firm can plan on a constant volume over a number of years it may well have lower costs than if a flexible plant is necessary. Short-run marginal cost of plants designed for a specific output would also be more inelastic than the short-run marginal cost of a flexible plant. The *discounted* marginal revenue function of a firm that can plan on a steady volume would likely be higher than that of a firm with highly variable outputs. A reduction in costs coupled with less discounting of revenue should have an output-increasing effect upon the firm.

When demand increases supermarkets can expand volume of a particular item by persuading present suppliers to expand or by taking on new suppliers (owner integration is, of course, another possibility). The same applies to the supplier, who deals in turn with a number of specialists. Buyers prefer to expand by getting their present suppliers to expand because the total cost of coordinating the output of firms increases as the number of firms coordinated increases. There is a cost incentive, there

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Many of the technological advances in farming and agricultural industry have been output-increasing. If this were not true they would not lead to specialization. The cost functions are reduced relatively more for the large scale enterprises than for the smaller ones. As integration reduces risk and encourages technological innovation, it also leads to expanded production of the integrated commodity.

Reduction of risk would normally raise the discounted marginal revenue of a firm or reduce its discounted marginal cost. Either would increase the optimum output of the firm. In many respects decision-integration in agricultural production has provided the same elements as a forward price support program. Floors are placed on the price of the product for the period of production. Producers know at the time they make production decisions approximately what net revenue to expect from their resources. Futhermore, the prices to be paid are established by private enterprise and there is little likelihood of encountering large surpluses such as have occurred under government price support programs.

Integration need not involve an exchange of resources. In many cases it is simply purchasing on contract. However, in most contract farming a resource exchange is a significant part of the integration. The broiler feed dealer contracts with the farmer to feed and grow the dealer's birds. Often feed dealers are faced with a problem of selling more feed or going out of business. It is not surprising that they choose to sell feed through their own birds. If contract integration operates like a lease to facilitate a more nearly optimum allocation of resources it is again cost reducing and quite likely output increasing. A lease facilitates the exchange of the use of resources which parties to the lease do not wish to sell, or for which they simply cannot find any better means of exchange.

Integration may also lead to a greater availability of capital because lending firms outside the integrated industry have more confidence in planned and steady production. Movements of capital within the industry may be easier because decision integrated firms will be familiar with any advantages of owner integration and therefore allocate their capital where it can earn the highest returns. Integrated broiler production has been characterized by competition among feed firms in extending credit to their grower customers. Some firms supply broiler houses, equipment, litter, and even fuel on credit to their growers. Broiler production has flourished, of course, in areas where this type of generous production-oriented credit is very necessary. Farmers with poor alternatives often forget their personal reluctance to borrow in the face of such tempting

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opportunities. The effects of this credit on output per firm are obvious. Supervision is another input made available to the contract farmer which can have a decided effect upon the size of farm enterprise. Particularly when an enterprise is undergoing rapid technological transition will the supervision accelerate the adoption of cost reducing methods. If the type of contract and the supervision encourage a grower to improve his methods and expand he may be able to do both at a more rapid rate than if he were on his own. (It should also be recognized that the unit cost of supervision would normally fall as the size of the units supervised in creases.)

The lower risk which results from integration together with greater availability of capital and supervision all suggest more rapid adoption of new techniques. The fact that many of the techniques are output increasing, in the sense that they favor large firms, and few are output decreasing, while almost all reduce costs, means that output per firm will expand

In summary, we submit that the same forces that bring about integration also bring about an expansion in the output of firms. At the same time, vertical integration results in these three conditions which are definitely output increasing: risk reduction, better resource allocation, and more rapid technological advance.

Owner integration achieves the same results as decision-integration and goes a step beyond it to assure long-run coordination and direct control. Any factors that cause an increase in output of firms under decision-integration should apply to owner integration as well. It is difficult to point to any real ways in which the joining of ownership, as an additional step, would cause any additional increase in the size or efficiency of firms. Actually, the services and capital of one manager are spread much thinner under owner integration and the size of individual sectors is often smaller.

# Vertical Integration and the Competitive Structure of an Industry

We have seen in the above section that vertical integration accelerates the forces operating in the economy tending to increase the size of firms. By reducing the costs associated with risk, vertical integration provides an incentive for expanded output of a product. In their drive to achieve efficiency and to reduce costs, firms are quick to adopt innovations leading to economies of scale when risk is reduced through integration. The process through which vertical integration increases the size of firms, therefore, often is a competitive rather than collusive process.

As long as firms in the industry remain competitive, a reduction in costs of individual firms should result in an increase in total output. The price should fall for the product and supposedly the public would be better

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off. If consumer welfare is thought of in terms of equality of the ratio of the price of each product to its marginal value product, then it is very possible for decision-integration to result in malallocation of resources in the sense that more resources will be allocated to the decision-integrated industry than to industries facing less intensive competition or more risk. Perfectly competitive industries would be expected to allocate resources in such a way that the ratio of the price of each input to its marginal value product would be unity when profits are maximized. Firms in industries characterized by large amounts of uncertainty, however, tend to equate the price of each input with a highly discounted marginal value product, thereby leaving the ratio of the price of the input to its marginal value product at less than unity. A reduction in risk through decision-integration, therefore, may cause excess resources to flow to integrated industries. Under these conditions we would expect the price of the product produced under vertically integrated production to be depressed relative to the prices of products in other industries.

As prices of products produced in vertically integrated industries fall, firms which cannot obtain the capital necessary for innovation will be forced out of business. If firms are going to become larger and fewer in number, then vertical-decision-integration will accelerate this tendency.

Vertical-decision-integration also affects the structure of some industries through elimination of the need for some marketing services. Decision-integration involves direct negotiation between farmers and processors. The services of terminal markets, auction markets, and other similar markets, therefore, are not needed in an integrated operation, and these markets may be expected to disappear except as they perform functions directly involved in the processing of agricultural commodities.

But, will vertical integration lead to more or to less competition in an industry? As rationalization of the industry takes place through attrition of the less efficient firms, the remaining firms will become more homogeneous. Profits are reduced and these firms may naturally seek to reduce competition through horizontal coordination.<sup>4</sup>

Vertical-decision-integration, therefore, could lead to horizontaldecision-integration. Even at present there is a distinct tendency in broiler production toward area collusion or even statewide bargaining groups.

<sup>&#</sup>x27;The most significant effects of horizontal coordination need not be accompanied collusion or even contact. Fellner made this point quite clear. "The difference between 'true' agreement and quasi-agreement is that the former requires direct contact while the latter does not. This difference is not always insignificant. But from the economic point of view the difference between true agreement and quasi-agreement is one affecting fine points more than fundamental characteristics of a problem. The distinction is analogous to that between 'collusion' and what we call spontaneous coordination." William Fellner, "Competition Among the Few," New York: Alfred A. Knopf, 1949, p. 16.

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We may expect a tendency toward bilateral monopoly as horizontal integration develops. One sector of a vertically integrated industry may have economies of size that reduce that sector to just a few firms. Collusion among these few firms may bring about collusion among many independent firms in another sector.<sup>5</sup>

Interest centers on the question of whether growers could be exploited by this sort of horizontal area collusion. As long as the collusion is not strong enough to restrict entry of new firms it is difficult to imagine any serious exploitation. If the colluding firms continue to expand total production, there is also little likelihood of grower exploitation. Exploitation would seem most likely if an area should stop expanding. Farmers could be kept in production at returns which just cover variable costs. With the many alternatives that are normally available to farmers, however, it is difficult to imagine they will remain exploited for any long period of time.

One answer of farmers to exploitation by horizontal highly integrated dealers is, of course, horizontal integration of themselves. However, this cannot achieve its objective without power to control the entry of firms into the industry and to regulate production. For this reason it is quite unlikely without government support. If other segments of industry become horizontally integrated, survival of the family farm may depend on the willingness of farm operators to integrate horizontally in order to gain strength in market decisions.

Many persons are concerned about whether the family farm will become technologically outmoded and its key enterprises owner-integrated. Survival of family farms depends upon the ability and willingness of farmers to adjust to changing economic conditions. In integrated systems of production farmers must become specialists in providing the services wanted by the market. Furthermore, they must be willing to coordinate their decisions with those of other producers in the industry. If farmers find it difficult to adjust or if gross inefficiency prevails in the industry, vertical owner integration will likely develop.

# DISCUSSION: IMPACTS OF VERTICAL INTEGRATION ON OUTPUT PRICE AND INDUSTRY STRUCTURE

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In general, the Seagraves-Bishop paper presents a rather orthodox competitive picture and analysis of vertical integration; indeed, rather too

<sup>&</sup>lt;sup>5</sup> The authors do not mean to imply that this is a particularly gloomy prospect. Bilateral monopoly may lead to certain efficiencies sooner than a system of oligopoly facing competitive sellers. See Fellner, *ibid*. Ch. 11.

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orthodox in view of our lack of knowledge about the adoption of technology, the efficiency of firms of various sizes, and the changes in market structures in relation to the functioning of the agricultural economy to name only a few.

The distinction made between "owner integration" and "decisionintegration" is important only if it leads to different results-in the context of their paper to differing outputs, prices and market structures. The fact that the greater portion of the output of a product is produced under conditions corresponding to the so-called "decision-integration" may only substantiate the proposition that this is the easier method to accomplish the same results. Different producers have different ways of arriving at the same costs and output. In the short run, the outputs and hence prices, in the competitive model posed in the paper would be the same under the two kinds of integration. As a matter of fact, the authors subsequently conclude that these two kinds will lead to the same output although the time period is not designated. Owner integration could result in the discontinuation or reduction in output because the short-run price in one sector of the integrated firm may be below marginal costs. However, even in the short run this possibility seems remote because it would cause a reduction in the output of the other sectors where price was above marginal cost. Even in the long run, assuming the same degree of competition or monopoly under each definition, output and prices would be expected to be the same.

Although the primary aim of integration may be cost reduction, as the authors state, the unified policy resulting from the coordination of activities leads inevitably to a limitation, if not to the elimination, of competition among the firms concerned. It would be interesting after integration had been in effect for a period of years, to have data on the portion of the factor or the product market which a given firm controlled in a given supply area. Moreover an extremely valuable study would be one designed to determine the impetus to integrate which the limitation of supply, by the integrating firm, forces upon the nonintegrated firms.

In general as the paper states, risk is reduced and hence output increased as the result of integration. But two important exceptions should be noted. One, many apparent reductions of risk turn out to be a transference or at most an averaging of risks. As the paper by Mueller and Collins and the discussion by Snodgrass¹ indicated, price uncertainty may be reduced, but the risk of letting a new contract is or may be increased in the long run. Second, the disappearance of alternative customers and

<sup>&</sup>lt;sup>1</sup>Willard R. Mueller, and Norman R. Collins, "Grower-Processor Integration in Fruit and Vegetable Marketing," *Journal of Farm Economics*, December, 1957, pp. 1471-1483. See also discussion by Milton M. Snodgrass, *Journal of Farm Economics*, December, 1957, pp. 1483-1486.

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sources of supply exposes concerns that must continue to rely upon the "free" or "open" markets to unusual risks. Here risk for the economy as a whole or for the industry has simply been transferred from one group of firms to another. And further, lack of alternatives may have effects on bargaining power similar to the effects of monopoly or monopsony.

There is serious doubt that the retail stores have or necessarily will play quite as passive a role in integration as the quotation by Thomas seems to indicate. Vertical integrating is the real role of giant retail organizations which makes them the key to competition in food industries. Large retailing organizations cannot practice price discrimination in the stages in which they do not operate, hence are unlikely to remain passive

The statement that a constant volume in the long run would lead to lower plant costs for an inflexible plant compared to a flexible plant, seems to implicitly refer to a single plant firm. But multiple plant firms or an industry can achieve flexibility by building and then opening and closing a number of inflexible plants. Do we know that such flexibility always achieves lower costs for the firm or the industry? And if the entrepreneur expects to be faced with price variation in the long run even a single plant firm may decide to build a flexible plant.

It is uncertain how the discounted marginal revenue of a firm with constant volume in the long run is higher than that of one with variable outputs. Under perfect competition the same long-run price variation would be facing both the flexible and inflexible plant or firm. Only on the assumption that cyclical price movements, as well as volume, will be dampened or nonexistent will the discounted marginal revenue of a firm be higher. Integration does not assure a dampening of business cycle

fluctuations.

That cost functions are reduced more relatively for larger than smaller scale enterprises is doubtful. If this point refers to a downward shift in the entire long-run curve, it would imply that new technology is generally oriented toward the relatively larger firm and that larger firms have a constantly widening margin of efficiency over the smaller.

In an excellent article, J. M. Blair presents evidence from widely different industries including bread, rubber tires, mixed fertilizer and superphosphate, which leads him to conclude: "Not only has this long-term increase come to a halt [in size of plant] but it appears that as a result of new decentralizing techniques in the fields of power, material machinery and transportation, technology is now tending to promote a smaller rather than a larger scale of operations." But it could be added, not necessarily a smaller scale of organization. It would be valuable in

<sup>&</sup>lt;sup>3</sup> John M. Blair, "Does Large-Scale Enterprise Result in Lower Costs?—Technology and Size" American Economic Review, Vol. 38 (1948) p. 151.

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The premise that integrated firms make more rapid technological advance is open to question. It seems to implicitly assume that the larger business enterprise resulting from integration, either through outright ownership or decisions coordination adopts technology faster than smaller firms. There seems to be little evidence and few reasons to indicate this to be true with two possible exceptions. One, where the fixed costs of the new technology are so high as to exclude adoption by the smaller firm; and two, where the development of the new technology is expensive and developed within the integrating firm. On the latter point most of the technology in agriculture, whether production or processing, is developed by firms independent of those integrating. How much do we really know about the adoption of technology in relation to size, age degree of competitiveness in the market and other characteristics of the firm? The greatest cost reductions seem to stem from organizational, and not mechanical or biological innovations.

I am not so optimistic as the authors that the market structure is apt to closely approximate the competitive model. The authors seem to shy away from their statement that "even at present there is a distinct tendency in broiler production toward area collusion or even state wide bargaining groups." A few small firms in an isolated supply area may exert equally as much private control of the market as is possible by giant corporations. And they might have added that often the forces making for combinations are not the economies that result, but the natural tendency to quit competing and combine.

# CONTRIBUTED PAPERS: OPEN SECTION MEETINGS

#### BILATERAL MONOPOLY IN FARM LEASING\*

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MYRON P. KELSEY AND MELVIN R. JANSSEN
Purdue University, and Agricultural Research Service, USDA

RARM leasing is a means of enabling one agricultural resource owner to combine his resources with those of another agricultural resource owner. This combination exists primarily as a means to achieve production. The functions of a leasing agreement, therefore, are twofold:

(1) to facilitate the control and organization of resources for production and (2) to distribute the product between the resource owners.

It is traditional in the study of agricultural leasing practices to use the theoretical model of pure competition. It is assumed that there are a large number of buyers and sellers. However, the tenant and landlord do not operate under purely competitive conditions. Their relationship is more like competition among a few buyers and sellers. This is especially true in part-owner operations where the owner-operator of a tract of land rents additional land. Distance between tracts under this form of leasing is a highly restrictive factor. When a farm (tract) becomes available for renting, there are only a small number of potential renters who learn about it. Few of these make any attempt to lease the farm. In fact, in a recent Indiana study it was found that approximately half of the landlords approached the tenant and asked him to operate the farm. In most cases of this kind it never becomes common knowledge that the tract is for rent. Similarly, for any tenant, there are few tracts in the area which he can rent, or because of distance or other factors considers it feasible to rent. In the same study of part-owners, it was found that the maximum distance from the home farm to the rented tract was nine miles and averaged one and one-half miles. Thus, most lease bargaining involving partowners very quickly becomes a single landlord and single tenant relationship.

The single tenant-single landlord relationship is more nearly that of bilateral monopoly than that of pure competition. This situation will continue for the duration of the lease, which usually is for one year with tacit understanding that it will continue for an indefinite period under "suitable conditions" which are seldom defined. A limited number of potential competitors is possible. However, the two individuals are highly dependent on each other to produce a common product(s). The share of the product is rigidly fixed by custom, but the shares of the inputs are not. Thus the two individuals bargain over which will provide each of the services required for production.

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Purdue Agricultural Experiment Station Journal Paper, Number 1373, Project 895.

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This is illustrated in Figure 1, assuming two individuals, the landlord and the tenant, exchange services. Assuming that both parties have perfect knowledge, we can make use of individual indifference maps and the box diagram as outlined in Scitovsky.¹ Here the main concern is with the efficiency of distribution of services between the landlord and the tenant when the share of the product is fixed but the total is variable.

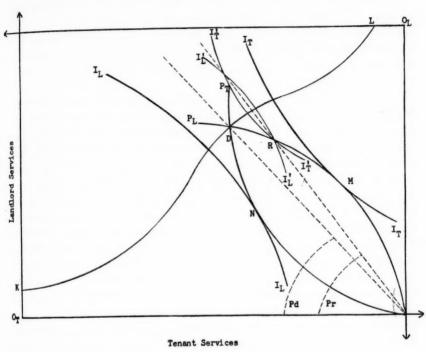


FIGURE 1.

If both were perfectly competitive, when  $P_{\mathtt{T}}$  is the price offer curve of the tenant and  $P_{\mathtt{L}}$  the price offer curve of the landlord, they would exchange services at D on the contract curve KL. The price, Pd, indicates the ratio of exchange of the value of tenant services for those of the landlord.

If either the tenant or the landlord should become a price maker, it would be to his best interest to set a price on the other party's price offer curve which is tangent to his highest indifference curve, such as at M or N. However, the threat of losing altogether the services of the other party will force each to set a price at some point between N and D or M and D. Hence, if either party is a price maker, trade will take place at some point off the contract curve, unless trade occurs by accident at D.

<sup>&</sup>lt;sup>1</sup>Tibor Scitovsky, Welfare and Competition, Chicago: Richard Irwin Inc., 1951, Ch. 19, pp. 414-422.

Bargaining is unlikely to lead to a price agreement alone; it usually also encompasses the quantities to be exchanged. Therefore, at any initial price that has been established, Pr, the tenant does not obtain as many landlord services as he would like and would be willing to make a price concession in return for more services. The landlord in his turn would be willing to pay for the advantage of lower-priced tenant services by offering more services of his own. In this way, the two parties can reach an agreement that brings them into an area enclosed by their indifference curves intersecting at R. The new situation is preferable to R for both parties. When the agreement brings the two parties to the contract curve it is final, as it does not leave room for a new agreement which is prefer.

able to both parties.

As far as efficiency is concerned, bargaining between the landlord and tenant leads to the same result as pure competition. The difference is confined to the division of responsibility for the contribution of inputs to the production process. It is not necessary for maximum efficiency that fixed inputs be divided in the same proportion as output or that each fixed input be paid according to its marginal productivity. This corresponds to the price-quantity agreement in which the landlord and tenant are bar. gaining for a total bundle of fixed resource services. Their relative bargaining power sets the price of the agreement. Since the quantity is simultaneously determined with the price, efficiency is not affected Strictly variable inputs follow the same pattern if both price and quantity are agreed upon in the bargaining process. However, if price alone is determined and the quantity of the service to be provided is left to the discretion of the contributor, then the equal proportions rule applied. When both price and quantity are bargained for, the cost of inputs need not be divided in the same proportion as the output. It is only necessary that the cost of inputs be divided so that the net value of the product of the input makes one party better off without affecting the other party's

If bargaining by both parties permits them to reach an efficient solution similar to that under perfect competition, why is there such a wide variety of agreements to be found in one type-of-farming area? This variety exists primarily because of three factors: (a) incomplete agreements, (b) differences in resource services available and (c) differences in

bargaining power.

It is unusual for parties in a leasing arrangement to make a complete agreement on all phases of a lease when they make the initial agreement. As problems arise, they negotiate further, adding to the area of understanding. Thus at any time, the lease may be incomplete in important details. This is particularly true if the lease has been in force less than a year.

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Differences in quality and quantity of resources affect the character of the lease. Even within a type-of-farming area, there are obvious differences in quality of land. Equally apparent are the differences in the resource services that can be provided by tenants. These services may be in physical inputs (including management) or may be in timeliness of performance of work. It is not unusual that, of two tenants with similar physical inputs, one can achieve vastly greater production because operations were performed in a more timely or better fashion. The landlord seeks to maximize his share of the product by selecting the tenant with the highest output from the combination of services the landlord must furnish. In order to secure a higher output, it is necessary to make some concessions on certain items to secure the services provided by the superior tenant. This contribution of the landlord may even be in nonproductive services such as a better dwelling. Less apparent than the differences already discussed are the differences in productivity of land that arise because of the difference in acreage of land owned by tenants or part-owner units. This affects timeliness of operation, and hence the productivity, of a tenant's services allocated to a rented tract.

Another source of differences among agreements may arise from the relative bargaining position of the parties involved. In some areas, where farms are small and a large proportion of them are operated by the owners, relatively few farms are for rent. Under these circumstances the demand for rented tracts is likely to be large and the supply small. The marginal productivity of rented land to the tenant in this situation is likely to be high when added to small tracts. While there is still a bargaining situation, the greater power is likely to rest with the landlord. Bargaining, therefore, does not take place between equals. At the same time, bargaining by tenants and potential tenants will under these circumstances move toward a desirable solution from the viewpoint of efficiency. The solution will differ from that under a situation of equal bargaining power.

#### Summary

It has been hypothesized that tenant-landlord relationships do not take place under purely competitive conditions, but under a system characteristic of a few buyers and a few sellers. This represents an efficient system under the assumption that bargaining for both price and quantity takes place. As a result of this bargaining, vastly different leases appear under a fixed system of sharing in the product. Workers in farm leasing can well spend more effort showing farmers and landlords how to bargain on a lease which provides for efficient production of the product. More efficient bargaining will contribute to efficient production, whereas undue emphasis on "equal shares" and "equal contributions" may fail in a dynamic situation where bundles of fixed resources become important.

# DECLINING DEMAND FOR PORK-RECONSIDERATION OF CAUSES AND SUGGESTED PRESCRIPTION FOR REMEDY

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PATRICK J. LUBY Oscar Mayer & Co.

THE demand for hogs and pork has been declining for about a decade. Very often the reasons given for the decline are fat pork and pork fat. Because of this, extensive publicity and effort have been expended to counter this excess fat with leaner meat-type hogs. However, even if the goal of all meat-type hogs yielding high quality pork is reached, it is likely that the hog and pork industry may continue to find itself in difficulty competing against other meats, particularly beef. This will be true unless many of the conditions existing during the past decade, apart from the lean-fat argument, which have been unfavorable to pork, are reversed.

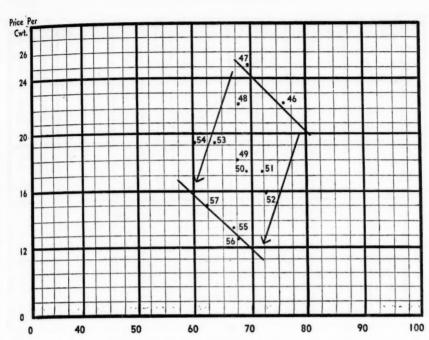
After rising from the 1930's, the demand for hogs reached a peak in about 1946 and 1947. Since that time, demand has apparently declined almost continuously. On the other hand, little variation in the demand for beef cattle is apparent during the same time. Thus, the demand for hogs has declined relative to beef cattle during the last 10 years. (See Figures 1 and 2.).

Comparison of deflated prices and per capita consumption also tends to show that pork demand has declined relative to beef since the end of World War II. Evidently there has been little relative change in average cost of production between hogs and beef cattle because the differences in demand have manifested themselves in widening differences in per capita consumption between pork and beef. Beef consumption per capita from 1953 through 1957 was the highest of this century. Pork consumption per capita in 1957 exceeded only seven other years of this century, four of which were from 1935 through 1938 when severe droughts cut grain and hog production.

While an improvement in the meatiness of the pork product probably would be one important step toward strengthening public acceptance and demand for the product, it appears that other factors, not directly associated with the degree of fatness of pork, are associated with the demand decline.

# Causes for Decline in Demand for Pork

The relative demand decline in pork corresponds to the revolution in meat retailing. There are probably several reasons for this. The merchandising of fresh pork at retail is hampered by a higher rate of store shrinkage relative to beef. Modern large meat departments tend to keep better



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FIGURE 1. AVERAGE PRICE RECEIVED BY FARMERS FOR HOGS AND PORK CONSUMPTION PER CAPITA, U.S.—1946-1957.

records and are better able to detect sources of waste and shrinkage. This tends to influence retailers and the shelf space they devote to different meat products.

Modern large supermarkets have initiated and promoted self-service retail meat operations with practically all meat sold under this system being pre-cut or sliced and pre-packaged. These cuts are then displayed and consumers select their purchases from those displayed in the meat case. Under such conditions, beef may seem more desirable because of its deep red color compared with the lesser-colored pork. Even the fat on these products might favor beef because the contrast tends to make the beef appear a deeper red in color, whereas the color contrast is not as great for many pork items.

Another factor associated with modern supermarket merchandising which may favor beef relative to pork is the policy of meat department managers to purchase within a narrow range of beef grades. Impersonal food retailing is built upon the principle of uniformity and consistency of the quality of the product. Beef is usually purchased within a very narrow range of a government grade by the supermarket. This tends to make the appearance and quality of beef very uniform, perhaps more uniform than

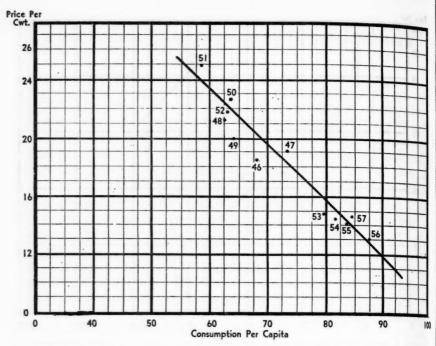


FIGURE 2. AVERAGE PRICE RECEIVED BY FARMERS FOR BEEF CATTLE AND BEEF CONSUMPTION PER CAPITA, U.S.—1946-1957.

pork. To the degree that this is true, beef probably gains in consumer appeal relative to pork.

Rapidly rising real income among consumers since World War II has also probably favored beef relative to pork. The recent government survey of United States households showed that as their incomes increased, consumers tended to eat more beef relative to pork.

The same study, when compared with a similar survey in 1942, showed that beef consumption of rural families has increased relative to pork. This has probably resulted from the urbanization of rural people's eating habits, better transportation to city retail markets, increased use of freezer in rural homes and less home slaughter of hogs on farms.<sup>2</sup>

Recent trends toward more industrial and school cafeterias has probably favored beef relative to pork since more pork is usually used in prepared luncheon meat items, a longtime favorite in pre-packed lunches. Despite this, per capita production of sausage items under federal inspec-

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<sup>&</sup>lt;sup>1</sup> Harold F. Breimyer, and Charlotte A. Kause, Consumption Patterns for Med, as reported in the 1955 Household Food Consumption Survey, A.M.S.-249, U.S.D.A. May, 1958, pp. 18-32.

<sup>&</sup>lt;sup>2</sup> Ibid., pp. 14-17.

<sup>\*</sup> J

tion has increased from 9.6 pounds in 1947-49 to 11.4 pounds in 1955-57, or almost 20 per cent. Evidently, little of this increase can be accounted for by increased vacation demand for prepared meats since production is a year-around process. The average index of production of sausage items from 1953 to 1957 varied only from 91.0 in December to 108.2 in July.

For years before as well as since 1947, the demand for bellies, from which bacon is made, has declined faster than for the other two major wholesale items, loins and hams. Lighter physical workloads for a large percentage of the population have probably stimulated a trend towards lighter breakfasts at which meal most bacon is consumed. The fact that bacon cannot be as quickly prepared as other breakfast items, such as eggs, cereals, juices and other beverages, may tend to decrease its demand in this age of quickly prepared meals.

The increased proportion of meals eaten outside the home may have added to the demand for beef relative to pork. Many pork items require longer preparation time and are thus handicapped at custom-cooked-to-serve restaurants. The fact that spareribs, a popular "eating out" item, has decreased in demand relatively less than other major pork cuts in recent years may indicate the importance of outside-the-home eating.

Since 1947, increases in consumption of poultry per capita may have competed more with pork than beef. However, a limited study in one city over 13 weeks by Farris and Baker indicated a greater cross-elasticity of demand between beef and poultry than between pork and poultry. This increase in poultry consumption has resulted from lower costs of production and supermarket merchandising of a uniform and consistent product.

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# Rate of Decline in Demand for Pork Items

Demand for different pork items has not decreased in the same proportion during the postwar years. Among the major products, demand for spareribs has probably declined least. (See Table 1). Yet, this product has one of the lowest lean to fat ratios among the major cuts. Demand for hams and loins has also declined less than for the average of all pork. The largest dollar and percentage declines have occurred for the shoulder items, picnics and butts, and for bellies. The dollar decline in prices of lard has been less than for any major pork meat item, but the percentage decline in lard prices has been greater. These comparisons do not seem to offer much evidence of greater consumer preference or dislike for fat cuts.

<sup>&</sup>lt;sup>8</sup> Paul L. Farris, and George Baker, unpublished study, Purdue University, Agricultural Experiment Station, 1957.

Table 1. Average Wholesale Prices of Various Pork Items, 1947–49 Compared with 1955–57

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Pork cut	W-:-ht	Average price/cwt.		Dollar	Percentage
Fork cut	Weight range	1947-49	1955-57	change	change
Spareribs	3/dn	\$39.81	\$34.66	-\$5.15	-12.9%
Loose Lard		18.00	11.33	-6.67	-37.1
Loins	8/16	47.76	40.82	-6.94	-14.5
50% Trimmings	,	24.18	17.02	-7.16	-29.6
Hams	10/16	49.45	41.75	-7.70	-15.6
Pienies	4/8	33.58	23.63	-9.95	-29.6
Bellies	10/16	38.53	26.27	-12.26	-31.8
Boneless Butts	11/41	53.36	38.96	-14.40	-27.0
Hogs, Chicago	(Drsd. Wt. 70% basis)	31.83	22.69	-9.14	-28.7

Source: Packers Daily Record, Published each week day by James P. Lennon & Co., Board of Trade Building, Chicago 4, Illinois.

Comparison of price changes of light and heavy weights of the same pork cut may offer some evidence of the importance of fat in the decline for pork, since the degree of fatness and weights of pork cuts are somewhat related. It is somewhat difficult to compare price changes since the volume of light cuts relative to heavy cuts has no doubt increased between 1947 and 1957 because the average weight of hogs marketed has decreased.

Statistics on production or consumption of different weights of cuts of meat are lacking and makes it difficult to accurately determine estimates of demand and changes in demand for cuts and various weights of cuts. Likewise, retail price series for pork also are inadequate. They do not usually take into consideration changes which have occurred in processing and merchandising methods.

However, it appears that wholesale demand for heavier hams, loins and bellies have not decreased relative to lighter cuts. (See Table 2). However, demand for heavier spareribs has not kept pace with demand for lighter spareribs. There appears to be little relative change in demand for heavy and light picnics and boneless butts.

# Relationship of Weight of Hogs and Demand for Pork

The demand for pork and hogs increased from the mid-1930's until after World War II and then declined. The weights of hogs also increased from the 1930's until 1945 and have since declined. (See Table 3.) One reason for this movement was probably the increasing, and later the decreasing demand for pork. However, on the other hand, the demand for pork increased for one decade despite heavier and fatter pork cuts. During the last 10 years, decline in the demand for pork has continued despite lighter, relatively meatier cuts because of lighter weight hogs marketed.

TABLE 2. AVERAGE WHOLESALE PRICES OF HEAVIER AND LIGHT PORK ITEMS, 1947–49 COMPARED WITH 1955–57

	Weight	Average price/cwt.		Dollar	Percentage
Pork cut		1947-49	1955-57	change	change
Hams	10/12	\$49.87	\$42.38	-87.49	-15.0%
nams	18/20	45.91	40.10	- 5.81	-12.7
Loins	8/12	49.06	41.48	- 7.58	-15.5
Loms	16/20	41.21	36.31	-4.90	-11.9
Bellies	10/12	40.57	27.37	-13.20	-32.5
Demes	18/20	33.01	22.34	-10.67	-32.3
	30/35	26.42	18.18	-8.24	-31 2
Pienies	4/6	34.02	24.18	- 9.84	-28.9
Liemes	6/8	33.14	23.08	-10.06	-30.4
Boneless Butts	11/3	54.49	40.05	-14.44	-26.5
Donciess Daves	$3/4\frac{1}{2}$	52.17	37.86	-14.31	-27.4
Spareribs	3/dn	39.81	34.66	- 5.51	-12.9
Sparerios	3/5	32.97	26.60	- 6.37	-19.3

Source: Packers Daily Record.

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## Recent Research in Meat-Type Pork

Some recent research has indicated that high quality, meaty pork would probably increase the demand for pork. In a recent 12-week test in 10 Indiana supermarkets, Cox, Stevenson and Smith found that the five stores handling only meat-type pork items sold about 6 per cent more pork than five similar stores of the same chain which handled regular pork. The sample was too small and the time period too short to indicate whether meat type pork would offset the decrease of about 25 per cent to 35 per cent in the demand for pork during the last decade.

There appears to be little evidence that fat pork or pork fat has caused a major portion of the decline in demand for pork and hogs since World War II. In fact, extensive publicity about overly fat pork and fat "cobroller" hogs may have itself contributed to the decline by imprinting upon the consumer an unfavorable impression of the quality of pork.

#### Conclusion

There seems to be little likelihood that the trends toward higher incomes, urbanization of farm families and supermarket merchandising of foods will be reversed. If the demand for pork is to be increased, more than research and publicity on meat-type hogs will probably be required

<sup>&#</sup>x27;James Stevenson and Norton Smith, Will the Meat-Type Hog Pay Its Way?, Economic and Marketing Information for Indiana Farmers, Purdue University, June 27, 1958.

Table 3. Average Live and Dressed Weight of Hogs Slaughtered under Federal Inspection 1930-39, 1947-49 and 1955-57

Time period	Average live weight	Average dressed weight
1930-39	229.8	172.2
1947-49	251.5	191.2
1955-57	237.0	180.9

Source: Livestock Market News Statistics and Related Data, Annual Publication, Livestock Division, AMS, USDA.

because fat pork and pork fat do not appear to be the major reasons for the decline.

Extensive research into better retail merchandising of pork under present conditions is needed. Publicity must also be changed to emphasize the good qualities of pork. Most industries do not usually emphasize their poorest grade of product which may represent 10 per cent or 20 per cent of total output, but the best grades of the product. Emphasis on the poorest grade can only continue to make pork known as an "inferior" meat and an "unhealthy" food item.

Despite these arguments the meat-type hog and meatier pork are worthy goals. Such a product might decrease the rate of decline in demand and perhaps even reverse it. However, if the goal is achieved and all hogs are meat-type yielding high quality pork, it is likely that the hog and pork industry may continue to find itself in difficulty competing against other meats, particularly beef, unless many of the conditions existing during the past decade which have been unfavorable to pork are reversed.

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#### SUPPLY RESPONSE TO GRAIN LAND RENTAL RATES\*

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THE Soil Bank Act of 1956 authorized the rental of cropland. The objectives of the act were (1) to decrease aggregate output, (2) to converse land resources, and (3) to increase farm income both directly by transfers of income and indirectly by controlling supply. As the effectiveness of the Soil Bank depends upon the amount of total participation, the national supply schedule of grain land determines the outcome of the program. Little information on the national supply schedule is available, but we do know that it is the sum of individual responses. Examination of the supply responses of individual firms to alternative rental rates will provide insight into the nature of the national schedule.

Knowledge of the national supply schedule and of individual supply response is needed in making future decisions relative to rental rates for grain land. Program administrators need to know the supply schedule for grain land rental to set the rates nationally and locally. Farmers who must ultimately decide whether to accept or reject a price and plan the use of their land need to know what their supply schedule should be. Some of the uncertainty otherwise associated with these decisions, could be removed by the insights that can be obtained through economic analysis.

The rate of payment for conservation reserve was increased from a national average of \$10 in 1958 to \$13.50 per acre in 1959 according to a recent announcement. State and local committees administering the conservation reserve have the task of setting the rates for counties, farms and individual fields. The rental rate for nondiversion land will increase from 30 to 50 per cent of the regular rate. A bonus of 10 per cent will be offered to farmers who place the whole farm in the Soil Bank. A cumulative goal of 22.5 million acres by 1959 and 31 million by 1960 was announced. Whether or not this goal will be reached is an empirical question. If the national supply schedule could be known the realism of this goal could be determined.

To gain insights into the nature of the national supply schedule an economic analysis was undertaken to determine the supply response of grain land on typical farms which combine their resources optimally. To insure an optimum allocation of resources at each rental rate, profitmaximizing farm plans were developed through the use of linear programming. The acres of grain land which would maximize profit at each rental

<sup>&</sup>lt;sup>e</sup> The opinions expressed in this paper are those of the author and do not necessarily represent those of the Farm Economics Research Division, ARS, or the Department of Agriculture.

rate were plotted against the rental rate to develop a stepped supply

response curve.

The analysis was made of a typical 160-acre, owner-operated livestock farm in the hilly Ida-Monona soil area of western Iowa. Under 1956 price relationships and average yields and management, profit would be maximized if 44 acres of corn, 24 acres of oats, and 52 acres of rotation meadow were grown and if the crops produced were processed through [] cows, a flock of chickens, and 20 feeding cattle or 10 litters of hogs. This is a typical farming operation for the area. The estimated net income of \$3,464 is the earnings of a year's labor, \$5,600 of operating capital, \$17,000 invested in land, and \$3,100 in machinery. This relatively low income raises a question as to whether these resources could earn higher returns in another use. Consequently, the problem for analysis here is the determination of the amount of resources which should be removed from grain production at varying rental rates for grain land and specified alternative

employment opportunities for labor and capital.

Three employment opportunities for labor and capital were considered in this analysis. (1) Complete reemployment of all non-real estate capital off the farm and full-time employment for the operator at \$1.25 per hour. Some farmers are willing to leave farming and are able to find work of the farm. If this is the case, what price must be paid per acre to remove the cropland from production? (2) The second employment opportunity consists of a 40-hour per week job off the farm for the operator, reemployment of capital at 5 per cent where it could not be employed more profitably within the business and part-time farming. If a farmer has this employment opportunity, what is the nature of his supply schedule for rental of grain land? (3) The third employment opportunity is limited to that available on the present farm. Some farmers are unable or unwilling either to leave farming or to become part-time farmers. For these typical full-time farmers, what price would make it profitable for them to rent grain land to the Soil Bank? One might ask also, what would be the effect on the acreage response at given rental rates if full-time farmers were permitted to graze the rented acres?

# Analysis

# Employment Opportunity 1

To remove resources from agriculture farmers would need to expect greater returns for the reemployment of their resources than they are receiving from farm operation. The farm analyzed could salvage \$7,300 from machinery, livestock, and operating capital. If the farmer could receive 5 per cent interest on the capital and sell a year's labor at \$1.25 per hour, \$520 per year in Soil Bank payments would supply as much income as farming. But to remove the land from production through the Soil which renta this i lated plus for p

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Soil Bank, the payment must be higher than the next best alternative, which is renting the land to another farmer. At customary cash or share rental rates, that would be \$1,700 per year. Thus the supply price for this farm in a whole farm program would be \$1,700. This may be translated into a conservation reserve payment of \$16.44 for eligible grain land plus 50 per cent of that for nondiversion land and a 10 per cent bonus for placing the whole farm in the Soil Bank.

This analysis established points on two supply curves which we may hypothesize are of the following nature.

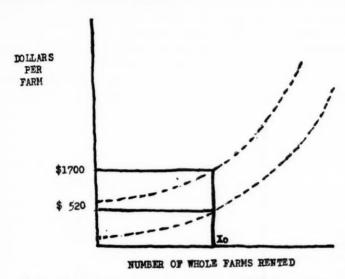


FIGURE 1. SUPPLY SCHEDULE FOR RENTAL OF 160-ACRE FARMS.

The upper curve represents the price that would need to be paid to outbid prospective tenants, the lower curve the price needed to equate the return from nonfarm employment with full-time farming. Xo is the number of farms that could be rented at \$1,700 per farm. All farms on which resources earn less than on the budgeted farm would lie to the left of Xo and would be available at a lower price. Knowledge of the supply relationships for whole farms would improve the ability of program administrators to set rates which would maximize the effectiveness of the Soil Bank program from limited resources.

As the number of farmers who are able and willing to leave farming in any one year is limited, the national goal for land in the program must be composed mainly of the responses of farmers who are willing to rent parts of their farms. The rest of this paper will be devoted to the nature of the supply schedule for grain land within a farm business that continues to operate.

## **Employment Opportunity 2**

To improve family income some farmers consider part-time farming. There is less disruption of family and community ties for a part-time farmer than for one who leaves agriculture entirely. About 40 per cent of the farms of typical size have 15 hours of family labor per week. These farms probably have the same quantity of other resources available as the full-time operator except for a maximum labor supply of 1500 hours per year. This employment opportunity provides more income than can be obtained from either full-time farming or complete reemployment. Some farmers consider this adjustment alternative but others will not because of the large number of hours required.

The relevant supply schedule for a part-time farmer is one for individual acres of his farm. The number of acres of grain that should be rented at each rental rate by a part-time farmer in order to maximize profit are indicated in Figure 2. Because the part-time farmer has limited

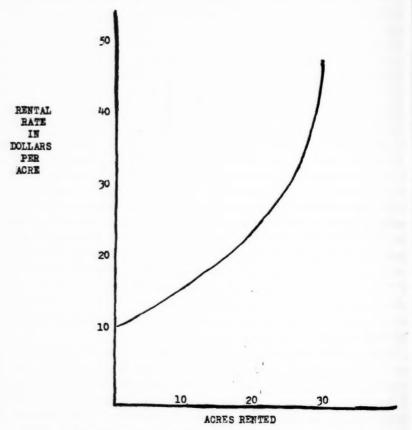


FIGURE 2. NORMALIZED SUPPLY SCHEDULE FOR GRAIN-LAND RENTAL FOR A PART-TIME FARMER.

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REN R/ DOLL/ PEI labor and cannot allocate large quantities of labor to expand the livestock program, he has few close alternatives to grain production. Thus the supply curve increases rapidly to the right. The supply curve for land renting is probably similar on other farms that cannot expand livestock production. Because opportunities for livestock production are limited by labor, operating capital is rented out for interest at all points on the supply curve. When the acreage of grain is reduced by 25 acres, only two-thirds of the capital formerly used in the business can still be profitably employed.

The income of the part-time farmer is \$5,700 at the lower end of the supply curve; it increases to \$6,100 at the upper level. It is possible that a part-time farmer would actually rent more acres at higher rental rates than are indicated in the figure, since by reducing his acreage he would avoid long hours of work during the planting season.

## **Employment Opportunity 3**

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Most farmers will continue full-time farming operations. The supply schedule for the renting of grain land on a typical full-time farm is indicated in Figure 3. It is most profitable to rent the same acreage over a range of prices because of the straight-line substitution possibilities within the business. For example, up to \$10.56, it is not profitable to rent any land. From \$10.57 to \$24.81, six acres of corn and six acres of oats would be eliminated from the eroded Ida soil which averages 17 per cent slope. This land is not very productive and could be rented quite cheaply. To move the better-quality land to less intensive rotations requires a

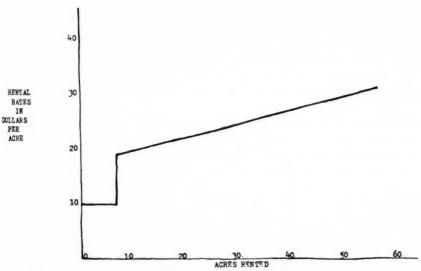


FIGURE 3. NORMALIZED SUPPLY SCHEDULE FOR GRAIN-LAND RENTAL FOR A FULL-TIME FARMER.

sizable increase in rental rates. When the price per grain acre reaches \$25, it becomes profitable to rent additional acres of the better grade land at relatively small increases in price per acre.

The typical full-time farmer has excess labor available which he cannot utilize profitably. Because of his labor supply, he can choose from among a wider range of livestock enterprises than the part-time farmer. Thus he can profitably reemploy within his business the resources not used in grain production. As a result of his reemployment opportunities the supply response curve for the full-time farmer is quite elastic at rental rates above \$25.00 per acre. The income of the full-time farmer would be increased about \$1,000 a year if rental rates of \$34 per acre were offered.

### Grain Land Rental with Grazing Privileges

A hypothesis may be proposed that controlling grain production by land renting could be achieved more cheaply by allowing farmers to graze the acres removed from grain production. Society might also gain through more complete utilization of available resources. Many soil nutrients cannot be "banked," that is, saved for the future or reallocated to nonagricultural uses. They are flow resources and if not utilized they are lost. Production and utilization of grass would allow conservation of these flow resources by converting them into products usable to society.

Payments for rental of grain land on which grazing or hay harvest is permitted would constitute a subsidy for forage production or, in an opportunity sense, a penalty on grain production. They would decrease the returns of all resources used in grain production relative to those

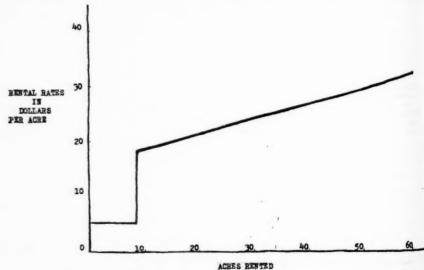


FIGURE 4. NORMALIZED SUPPLY SCHEDULE FOR GRAIN-LAND RENTAL WITH GRAZING PRIVILEGES FOR A FULL-TIME FARMER.

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used in grass production. On some kinds of land a rather small fixed annual payment would shift land from grain to grass. Land rental payments would provide a compensation for the uncertain income from grain and a fixed immediate return on resources used in establishing grass.

A supply schedule for grain land renting with grazing privileges for a full-time farmer is presented in Figure 4. Reduction of uncertainty provided by land rental payments is ignored in the analysis. Any reduction in uncertainty would cause the supply schedule to move to the right. No government cost sharing was assumed in developing the supply schedule. This supply schedule lies generally below and to the right of the supply schedule for grain land rental without grazing privileges.

Subsidation of forage production in the corn belt would appear to transfer the excess resource problem of the corn belt to the range lands. However, generally less meat would be produced from an Iowa farm used for forage than from the same farm used for grain production. As a result total meat output might be decreased and livestock prices increased by a grain land rental program with grazing privileges.

#### Conclusions

From an economic viewpoint, if the cash cost to the government of reducing grain production by land-renting is to be minimized, a priority of spending should be established as follows. Farmers who want to quit farming should be compensated in a lump sum for their land. These farmers would move their resources out of production and either into retirement or to employment in other sectors of the economy. Rental rates would need to be high enough to compete with farmers who want to enlarge their farms. Second, a limited amount of low-production land should be rented from part-time farmers or full-time farmers. Third, land should be rented from full-time farmers and allowed to go into forage production. The cost per acre of grain land rented would be lower if it could be grazed.

The direct effect on the incomes of farm families of a land-rental program would probably be minor. Greater gains in income could be made by many farmers by reallocating part or all of their resources to other employment in which they could be employed more fully and productively. Labor and capital whose return is relatively low in grain production could be shifted to livestock production or unemployed through a grain land renting program. However the total return to the owner of these resources cannot be increased substantially if they remain in agriculture. Society would probably receive a greater total value product if the capital and labor receiving a low return in grain production would be reallotted to other sectors of the economy and the land used in forage production.

#### COOPERATIVE MERGERS AND RESEARCH NEEDS

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#### The Problem

T OFTEN is stated that farmer cooperatives need to be pace-setters1 This means they must be soundly organized and operated, and have business units which are big enough and sufficiently strong that they can perform high quality service efficiently. Furthermore, it suggests on operatives must be in a position to set the pace for competing agencies so that competitors would be stimulated to render better and better serv. ice. Each of us probably could give illustrations of farmer cooperatives which are pace-setters in every sense of the term. But there is considerable evidence which suggests many farmer cooperatives are falling far short of setting the pace in one significant aspect of business organization -in the rate of growth and average size of individual business firms.

Everywhere about us there is the presence of bigness in business, and the trend toward fewer, yet bigger, business units is increasing in tempo. Business firm mergers are the chief means of growth for most concerns. Therefore, one can appraise the extent of firm growth by analyzing acquisition activities. A current research study gives us an insight into some significant business concentration developments.2 Paul E. Nelson, Agricultural Marketing Service, is studying acquisition activities of the following food industries; dairy products, bakery products, wholesale food trade, and retail food trade. His data revealed acquisition activities were almost entirely a matter of large firms taking over smaller ones. He reported one out of three of the firms in his study had made acquisitions during the 1946 to 1956 period, and that those making acquisitions averaged six acquisitions per firm. Nelson's data provide interesting empirical evidence that industries in which farmer cooperatives are operating and industries with which farmers deal directly are very active in increasing the size of individual firms through acquiring established

Have cooperative business firms grown to the same extent as ordinary business firms? Do cooperatives use merger techniques and acquire other firms (cooperative as well as non-cooperative) to the same degree as their

<sup>&</sup>lt;sup>1</sup> The role of pace-setter has been held by many students of cooperatives to be the primary purpose for the existence of farmer cooperatives. See H. E. Babcock "Cooperatives, The Pace-Setters in Agriculture," Journal of Farm Economics, February, 1935, and also, John H. Davis, "The Place of Cooperatives in a Sound Farm Economy," Journal of Farm Economics, November, 1947.

Paul E. Nelson, Jr. "Ownership Changes Within Selected Food Industries—A Progress Report," The Marketing and Transportation Situation, April, 1958.

competitive counter-parts? Decidedly not, according to some research investigations of Willard F. Mueller, University of Wisconsin.<sup>3</sup> In fact, he concluded from his research that one major reason why cooperatives have not done as well in competing with non-cooperatives can be traced to the fact that they haven't used mergers to the extent that non-cooperative businesses have used them.

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Others in addition to Mueller have observed that the average size of cooperative businesses has not kept pace with that of competitors and have urged cooperatives to take immediate remedial action. We cannot ignore the point that cooperatives must grow and develop larger business units if they are to give meaning to the term "pace-setter." The technique of merger is a primary means whereby cooperatives could accomplish this. But often it is noted that cooperatives are hesitant to use this technique of growth. Why is this? Why do so many cooperatives ignore merger opportunities? What does the merger technique have to offer cooperatives?

These are pertinent questions and ones which need answering. Since research is a technique of searching out answers, it is obvious that research on cooperative mergers is needed.

## Why Consider Mergers

Any proposed changes which would alter established policies of an organization should be considered carefully and thoroughly in light of the objectives of that organization. Therefore, any proposed cooperative merger should be analyzed in terms of the objectives of those cooperatives. To raise the question, "Will a merger strengthen the cooperative?", one is really asking, "Will a merger help the cooperative to attain its objectives?" Before one can evaluate possible advantages of a given merger, a clear understanding of the objectives of the associations involved is needed.

For purposes of this discussion it is useful to view cooperatives as having a dual objective: (1) to succeed as a business entity, and (2) to succeed as a cooperative enterprise. The two are related closely but it is possible to achieve one and not the other. Only when both are achieved simultaneously can the activity truly be called successful. It is suggested

<sup>&</sup>lt;sup>3</sup> Willard F. Mueller, "Will Cooperatives Sink or Swim in the Sea of Mergers?" Mimeographed Paper presented July, 1957, at the Summer Directors Conference of the Wisconsin Council of Agriculture Cooperatives, 1957.

<sup>&</sup>quot;For two excellent statements urging cooperatives to increase the average size of their businesses see Homer L. Brinkley, "Research Challenges to Farmer Cooperatives," Proceedings of Southwestern Regional Conference on Resarch in Agricultural Cooperation, p. 19, October, 1956, American Institute of Cooperation; and M. J. Briggs, "Cooperatives in our Big Business Economy" p. 5. American Cooperation, 1957, American Institute of Cooperation.

that mergers could have a great deal to offer cooperatives in carrying out both aspects of their dual objective; namely, (a) to strengthen economic efficiency and (b) to improve the functioning of cooperative aspects of the association.

#### Research Needed

Farmers have demonstrated time and time again they can act intelligently in solving their problems when they have the necessary information. Research is needed to understand more fully the kinds of problems which confront farmer cooperatives in carrying out mergers. Also, information is needed to show more clearly when cooperative mergers are needed and how best to effect them. Three kinds of studies are suggested to facilitate cooperative mergers.

#### **Economic Studies**

Most students of farmer cooperatives view them first of all as economic institutions. Therefore research is needed to investigate possible economic effects of mergers. Case studies of types of situations encountered would seem to be a reasonable approach in this kind of study. For example, case studies could be developed analyzing actual situations of a grain elevator association and a farm supply cooperative operating as separate business firms in the same town. Budgets could be prepared appraising a hypothetical merger of the two businesses. Also, case studies could be made to estimate possible results of a small outlying association merging with a larger and stronger one of the same type. Economic evaluations which the studies might reveal would be very useful to those in positions of leadership in making decisions affecting cooperative mergers. The main point here is that economic studies are needed which managers and directors could see were applicable to their situations and ones which were easily understood by them.

# Observations of Successful Mergers

To be effective in dealing with mergers, research workers must become familiar with the kinds and extent of problems involved. Some problems encountered stem from the special manner in which a cooperative handles its internal affairs. For example, the many equity and creditor capital instruments issued by a cooperative and held by its members must be considered and appraised. Very likely associations involved in a merger would have vastly different financing programs. Each association's finances must be studied carefully and understood thoroughly before the two financial structures could be merged effectively into one. The extent of members' accounts receivable, and policies for handling corporate re-

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serves, are additional examples of aspects of internal cooperative operations which research workers must understand thoroughly in order to work effectively with cooperative mergers. Case studies of successful cooperative mergers would be invaluable to familiarize research workers with the kinds and extent of problems involved in making cooperative mergers.

## Sociological Studies

Cooperatives are associations of people. Therefore, many problems encountered in mergers have their origin in sociology. For a cooperative to be effective, its *members* must learn to work in harmony. But in the event of a merger, two or more *groups* must work together, which introduces new relationships and consequently new problems. Assistance from sociologists is needed to cope with these kinds of problems. Investigations are needed which will supply information on what is needed to motivate people to consider mergers. Also, cooperative leaders need to know which approaches groups should use to get best results.

#### Conclusions

It is to be emphasized that cooperative mergers are not to be considered as an end in themselves. But it is argued here that many farmer cooperatives need to grow larger in order to be effective as economic entities as well as cooperative institutions. The technique of merger appears to be a practical means of achieving growth of individual units while eliminating weak ones. Research is needed to learn more about the feasibility of cooperative mergers, to determine factors that are limiting more extensive use of the merger technique, and to show what remedial action must be taken to overcome the limiting factors.

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# ARE NEW CRITERIA NEEDED FOR MAKING AGRICULTURAL LOANS?

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FRANK MILLER
University of Missouri

THE difficulties encountered in gaining control of the necessary resources for operating an adequate family farm business are increasing. The consumer wants quality products; the processor wants a uniform flow of material through his plant, and the retail merchant a dependable supply of goods on his shelves. These desires are forcing production toward quantity output on individual farms and concentration of supplies in relatively small areas. The small farmer with a diversity of enterprises has difficulty in meeting these requirements. Very few proces. sors are interested in the volume and quality of products the unspecial ized small producer has for sale. The bulk tank is replacing the milk can. The cream station has disappeared from most rural villages, The average price of eggs from small farm flocks does not meet production costs. A few bushels of tomatoes or apples in excess of the needs of a farm family are economic waste. The grower cannot afford to take them to a consuming market and there is no demand for them locally. In other words, a considerable volume of output is essential to a profitable business; and superior skill is required to set up and operate a farm business that will turn out this volume. The problem has many facets, but the discussion here will deal with the need for capital, and for new procedures in making it available to farmers.

The investment in a general livestock farm in central Missouri that will return \$4,500 a year to labor and management is about \$61,500. A Missouri dairy business that will return \$5,700 a year will require an investment of approximately \$50,000. In the Cornbelt it is not unusual to have investments approaching \$200,000 in commercial family farms. Satisfactory poultry businesses can be set up with less money than is required for dairy farms, but investments are fairly large regardless of type of major enterprise. If it is assumed that these investments represent normal values, the equities required to finance satisfactory businesses at conventional debt ratios vary from \$20,500 to \$82,000. In a general farming area, the business requiring \$20,500 would be the smallest that could be considered adequate. A high percentage of farms do not come up to this standard.

<sup>1</sup> James E. Dillon and Robert C. Suter, "Let's Study Your Farm Business," Missom Agricultural Experiment Station Bulletin 603, page 7.

<sup>&</sup>lt;sup>2</sup> Robert C. Suter, "Compare Your Dairy Business With An Analysis of 56 Central Missouri Farms," Missouri Agricultural Experiment Station Bulletin 614, page 4.

Approximately one-fourth of our farms are in good technological adjustment. The acreage of cropland is adequate for low cost use of equipment, and the livestock enterprises are fully adjusted to the feed base and the labor supply. The operators have plenty of collateral to offer for loans. Another one-fourth are in fairly good technological adjustment. Most of the operators in this group also are able to qualify for credit

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The people who need new criteria for making loans are in the 50 per cent of farmers who produce approximately 10 per cent of the products that move in channels of trade. The problem has three facets. One deals with adjustments in resources to make existing operating units more nearly adequate to compete in our present dynamic economy. In some cases two or more small farms need to be combined into a single adequate unit. In other cases small inadequate acreages need to be joined with more nearly adequate units in order to bring the combination of factors closer to the optimum than the situation that now exists. Farmers' Home Administration is attacking this problem through its loan program for farm enlargement. Other agencies such as insurance companies and the Federal Land bank also are making loans to farmers who qualify under present rules for the purchase of additional land that will give them more nearly adequate acreages for carrying on their enterprises. Through time, a considerable amount of adjustment in combination of resources will take place, but the process is extremely slow.

Another phase of the financing problem deals with procedures that will aid new operators in getting established in farming. A study of 152 farm businesses operated by men who started farming in northern Missouri and southern Iowa in 1953 showed that only 13 began as owner operators, 17 started as part owners, and 122 as tenants.3 More important, however, was the net worth of these operators and the total assets that they were able to control. Those starting as owner operators had an average net worth of \$9,314-less than one-half the smallest amount required for a satisfactory equity in a minimum farm business. The total assets controlled by these families were \$10,253, slightly more than onefifth of the minimum capital needed. Their net farm income averaged \$831, scarcely enough for subsistence. Off-farm work and gifts brought the total family income to \$1,800, which is too low for the minimum needs

of a family.

Despite the low level of income these families increased their net worth an average of \$405 a year in the 1953-55 three year period. This

<sup>&</sup>lt;sup>3</sup> Ted L. Jones, "Progress in Becoming Established in Farming in Southern Iowa d Northern Miscouri" I Inpublished Manuscript, Department of Agricultural Ecoand Northern Missouri," Unpublished Manuscript, Department of Agricultural Economics, University of Missouri.

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rate of gain cannot be considered satisfactory. Unless accelerated, 27 years would be required to raise the family net worth to the \$20,500 minimum needed to finance an efficient business. At that time these men would average 52 years of age, and they would still have several anxious years before their financial condition would justify a feeling of security.

Those who started as part owners had net worths that averaged \$9,483. By leasing additional land they were able to establish businesses valued at \$25,341. Their net farm incomes averaged \$2,194, and with off-farm work and gifts they had total family incomes of \$3,958. This amount was the highest of any group, but more than one-fourth (26.1 per cent),

came from gifts.

The net worth of the tenants averaged only \$5,348. Through various types of leases they were able to get control of assets valued at \$27,419. Their net farm income averaged \$1,889. Total family income was \$2,971. Very few of these men had businesses that represented efficient combinations of resources. Most of them borrowed some money. Many did not use as much credit as they could have obtained. A few tried to get more funds, but were turned down primarily because of insufficient security.

The great majority of beginning farmers enter agriculture as renters. The problem here is to find an adequate farm and to equip it so land and capital are in balance with the labor supply. The plain facts are that most of the farms available to beginning tenants are inadequate.

A third phase of the farm financing problem deals with inadequate businesses that continue to be operated. Contract farming appeals strongly to these people and to other groups who abhor the risks associated with agricultural production. The situation suggests that inadequate farm businesses may be one of the principal causes of contract farming. The use of contracts to finance larger enterprises is evidence of a desire to overcome this handicap. If the criteria used in making loans will not permit people who have very little property to pledge as collateral to get financed, then processors and merchants who want depend. able supplies of quality products are likely to furnish the funds needed. The procedure is not new, but it is beginning to assume proportions that will force existing credit agencies to make substantial changes in their lending practices. Data presented at the Eighth Annual Meeting of the National Institute of Animal Agriculture at Purdue University, April 20-22, 1958 show that 90 per cent of the broilers, 50 per cent of the turkeys, 10-20 per cent of the grain-fed cattle, 25 per cent of the lambs and some what less than 10 per cent of the hogs are finished for slaughter under some type of contract.4 Processors, feed companies and chain super

<sup>\*</sup>Impact of Integration, American Feed Manufacturers Association, 53 W. Jackson, Chicago, Illinois.

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markets are entering the field in large numbers. Their activities are not restricted to the meat business. Fruits and vegetables are grown under contract too. It is altogether possible that agriculture is entering a phase of finance that will be somewhat similar to the procedures used in supplying parts to manufacturers and in selling automobiles, trucks and other types of heavy equipment. Processors and retailers may set up financing divisions to provide farmers with the funds needed in producing crops and in finishing livestock under financial arrangements similar to those used in other industries. The emphasis will be upon quality of product, efficiency of gains and even distribution of supply rather than upon the per cent of equity the grower or livestock producer has in his business.

This new procedure easily can change the pattern of supplying working capital to farmers. Commercial paper issued by feed manufacturers, processors and national food chains soon may be available to investors along with the debenture bonds of the Intermediate Credit banks and the commercial paper of organizations like General Motors Acceptance Corporation. Under these conditions commercial banks and production credit associations easily can cease to be the most important sources of production credit.

Changes of equal magnitude are coming into the financing of farm real estate. Among them are the purchase of farms under installment contracts. In some instances sales to men with small equities are sponsored by agencies such as the Texas Veterans Land board. At one time two out of every five bona fide sales in Texas were to this board.

Studies in Minnesota indicate that a high percentage of farm transfers are on contracts of various kinds. A considerable proportion of the sales in Iowa are on installment contracts. The arguments in favor of this procedure are (1) the buyer obtains control of a farm with a very small down payment, and (2) the seller receives an annual income that may be, for him, a type of annuity and escapes a considerable part of the capital gains tax. This could become a very popular procedure among owners who are ready to retire. Here, again, the agencies that have been making loans secured by real estate mortgages are likely to face a gradual shrink in volume of business, if they cannot make loans for a higher proportion of the market price than is the practice now.

A quick glance at financial conditions in agriculture reveals the fact that new procedures in making both production and real estate loans is needed. The problem is particularly acute where operating units have not been adjusted to the new technology that is available to farmers.

The situation is confused because of the mixture of well financed farms with units that are poorly financed and inefficiently managed.

Careful differentiation between these two situations would make it possible to continue making loans under the old criteria of ratio of net worth to total assets for those borrowers who have an adequate basis for credit and to finance other businesses under a new set of criteria for those people who want to farm but have very little savings to invest in a business. In this latter group it will be necessary to transfer emphasis from percent of equity to efficiency in combination of economic factors and adequacy of income to meet operating costs, provide for a farm family and leave a surplus out of which the debt can be serviced.

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It is altogether possible that experience with this second form of farm finance would be equally as satisfactory as with the conventional form. However, it will be necessary for lenders who use it to give careful attention to quality of management. This procedure may not be the best one that can be devised. It is clear, however, that agriculture needs new methods of financing both production of commodities and transfer of farm land. If existing credit agencies cannot meet this need, they can look forward to an increasing volume of farm sales under installment agreements and to rapid expansion in production of agricultural commodities under some form of contract with feed companies, processors and retail chain stores.

### MAKING FARM FAMILY PLANS MORE EFFECTIVE

RICHARD A. KING North Carolina State College

ONVINCING farm families that it pays to make effective financial plans a year in advance is a difficult task. Some of the reasons for the difficulties are apparent. Not only is total farm income for the coming year uncertain, but it is certain that income will vary widely from one month to another even if the total is accurately estimated. Furthermore, it is in many cases impossible to separate farm investments from farm family investments. Finally, the goals of the farm family can not and should not be separated from goals of the family farm.

The need for consideration of improved methods for planning farm family expenditures is great, and the results from 15 years of attempts to make effective family plans and from discussions with the home agents

produced the ideas which follow.

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Perhaps the most effective change in budgeting procedures would be to abandon systems which call for averaging monthly income and monthly expenditures for a 12-month period. This is not unlike averaging salaries over a 30-year career and expecting to find any one year matching the average figure derived in this fashion. Especially is this procedure dangerous when working with farm families whose incomes fluctuate violently from month to month and whose expenditures are likewise subject to wide seasonal variation.

In place of the average monthly budget, the allocation of expected monthly income in each of the 12 months under consideration appears preferable. This would make it possible to use more accurate estimates of income available to the family in various seasons of the year and would provide a basis for planning monthly family expenditures. The need for consideration of monthly income and expenditure patterns is clearly illustrated in Figure 1 for a farm in eastern North Carolina which differs from hundreds of farms throughout the country only in the size and seasonal distribution of income. We have used this method of monthly budgets for several years and a recent publication entitled "Family Finance Diary" published by the magazine *Changing Times* provides a detailed procedure which can be followed readily.

A second recommendation involves the use of the concepts of fixed and variable expenses in planning for 12 months in the future. Under such a system one might divide expenditures into contractual expenditures, regular monthly expenditures and other items of expense. This three-way split makes it possible to see exactly which of the expenses one is committed to meet in the short run and which of the items of

expenditure are subject to manipulation. In Table 1 three columns are provided for each month: these show last year's expenditure, expected ex-

TABLE 1. MONTHLY CASH FORECAST<sup>a</sup>

	Month			Month			Month		
Cash Forecast	Last	Est. this year	Actual	Last	Est. this year	Actual	Last	Est. this year	Actua
Cash on hard and in checking ac- count, end of previous period									-
RECEIPTS									-
Net pay									-
Borrowed									-
Other									-
Total cash available during period									
FIXED PAYMENTS									
Mortgage or rent									
Life insurance					-				
Fire insurance									
Auto insurance									
Savings		-							
Local taxes					-				_
Loan or other debt									
Other									
Total fixed payments									
VARIABLE PAYMENTS									
Water									
Light							-		
Fuel									
Telephone									
Medical									
Car									
Food									
Clothing									
Nonrecurring large payments (Contri., etc.)									
Other									
Total variable payments									
TOTAL ALL PAYMENTS									
RECAPITULATION									
Total cash available					F				
Total payments									
Cash balance, end of period									

a Based on "Family Finance Diary" Changing Times, The Kiplinger Magazine.

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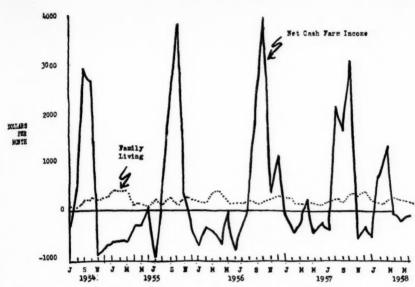


Figure 1. Net cash farm income and family living expenditures by months, Selected farm in eastern North Carolina, July 1954-June 1958.

penditure this year, and actual expenditure this year. The column showing last year's expenditure provides a basis for intelligent planning of expenses for the current year while the third column is useful in evaluating the plan at the end of the year and in providing a basis for the succeeding year's plan.

It may also be useful to deviate from the more or less standard practice of allocating a single column in a farm family account book for each of the major items of expense and concentrating those that are contractual or once-a-month type of expenditures in a single column at the right. One of the most effective account books following this practice is entitled, Spend and Save, published by Shaw's and illustrated in Table 2.

It seems desirable to place more emphasis on planning two to five years, perhaps even 10 years, ahead into the future. This is especially important if one hopes to get at the "fixed" items in the budget. A graphic analysis may be satisfactory for this purpose, such as that suggested by Figure 2, if the goal is to help families weigh alternatives that involve relatively large fixed commitments.

The concept of interest as described in many of the materials provided farm families for planning purposes seems to be unnecessarily complicated. We might well play down the use of interest as a basis for decision making and concentrate instead on alternative flows of cash that are required to achieve particular purchases. This is not to say that interest rates are unimportant, but simply that the boiling down of

TABLE 2. SAMPLE MONTHLY CASH EXPENSE RECORD.

75.6	Gross income before deductions	ncome	Income	Other	Pood	Clothing		Occasional and once a month expenses		Savings
Date	Source	Amount	withheld	deducted	2007	S S S S S S S S S S S S S S S S S S S	Date	Item	Amount	investment
1								Rent		
35								Interest on mortgage		
8								Fuel		
4								Gas		
10								Electricity		
9								Telephone		
2								Water		
œ								Real estate taxes		
6								Repairs on house		
10								Life insurance		
					į					
91								Other insurance		
TOTALS	87									
Впра	BUDGET ALLOWANCE	INCE								
IFFERI	DIFFERENCE BETWEEN ACTUAL EXPENSES AND	EEN								

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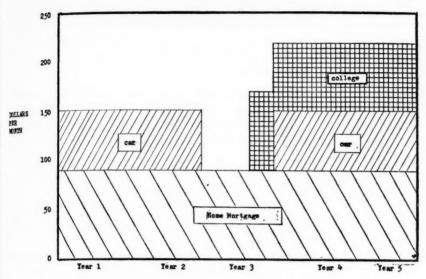


FIGURE 2. EXAMPLE OF FIVE-YEAR PLAN FOR HOME MORTGAGE PAYMENT, CAR PURCHASES AND COLLEGE EXPENSES.

a flow of expenditures into a single figure such as 5 per cent, or more likely 15 per cent, serves to confuse the farm family in making a choice of one flow of expenditures over another.

Short-run decisions such as the use of fluid whole milk, the combination of half and half fluid milk and nonfat milk powder or the use of 100 per cent powdered milk is a rather simple choice as compared with many of the decisions faced by farm families. These more complicated decisions often involve more than one initial outlay and a flow of services over several months and often a number of years. The book by Lutz and Lutz entitled *The Theory of Investment of the Firm* outlines rather clearly some alternatives to the practice of estimating interest charges, depreciation rates and costs of current repairs. In particular these authors suggest that decisions be viewed in the light of a flow of income, or services in the case of the farm family, and a flow of expenditures which may be discounted to the present. This discounting to the present of income and expenditure flows makes it possible to compare much more effectively investments in the farm with the purchase of, say, a new car for the farm family.

Finally, emphasis should be placed on the control of the plan as the year progresses and on the evaluation of the plan at the close of the year in the light of farm family goals. While the above proposals concentrate on the planning aspects of farm family budgeting, it should not be concluded that the other two areas of budgeting are of any less importance.

DIFFERENCE BETWEEN ACTUAL EXPENSES AND BUDGET ALLOWANCE

## POSSIBLE FUTURE TRENDS OF VERTICAL INTEGRATION IN AGRICULTURE

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W. P. MORTENSON
University of Wisconsin

WE ARE literally bombarded these days with statements that integration will change, if not revolutionize, our system of producing, processing, and marketing farm products. Newspaper and magazine articles, the radio and even television seem to be trying to out do each other for public attention on the question. The subject is discussed freely by laymen everywhere with mixed emotion, noticeable confusion, and often with some alarm. Just what are the facts? What, if any, revolutionary changes as a result of vertical integration might we expect on our farms and in the processing and marketing of farm products in the next five to 10 years?

Vertical integration as used here means a tying together or linking of two or more steps in production and marketing. This is done by centralizing control and management with a view to improve the competitive position of a business enterprise. In this paper the definition shall be limited to include a *linking of two or more hitherto separate firms* and shall deal chiefly with the type of integration from the farm to the first receiver. The changes wrought in the market structure are fully as important in food distribution and might well have been a subject of a companion paper.

In attempting to point out and analyze, at least in part, some of the economic forces which encourage vertical integration and certain forces which tend to deter its progress, it is hoped that this paper will provide certain guide posts to show the extent to which vertical integration will find its way into the various phases of agriculture in the years that lie

immediately ahead.

Integration in its various forms is not new in business and industry. Integrated or industrial combinations have existed in America and other nations for more than a century. The combining of several complementary business enterprises have varied in character from complete mergers at the one extreme, to loosely drawn cartel agreements at the other.

Through the certain types of mergers, the manufacturing plants, the financial structure, and the sales organizations of hitherto complementary units are united into a new, fully developed business enterprise.

Perhaps the most complete vertical integration is found in the oil and gasoline industry where control is maintained by one ownership from the oil well to the retail gasoline service station. However, any number of other illustrations could be cited.

In agriculture the illustration most commonly cited is the broiler industry. For more than two decades this industry has had a startling rate of growth coupled with a rapid improvement in nutrition, genetics, management, processing, and distribution. Because of this situation the industry has been in a constant state of flux and has been faced with an extremely competitive condition having narrow margin of profit in every phase of its operation. Vertical integration has lent itself especially well as a way of reducing unit costs of operation from the beginning of production until the pan-ready birds are available in retail food stores for the shopping lady.

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In the more typical integrated broiler operation the feed supplier controls the operations of the grower, determines to a greater or lesser extent the feeding and management program and decides when and where the birds are to be sold. This is relatively complete vertical integration centered in one organization—the feed supplier who is the integrator and the organization in control.

A slightly different form of integration in this industry is a contractual arrangement between the feed supplier, the grower, the processor, and the buyer of the processed birds. While integration in turkey production and marketing has had only limited publicity compared with broilers, the same general pattern of integration is found there.

There are certain basic economic advantages of vertical integration which apply effectively to the broiler industry—and a few farm products handled in a similar manner—but which apply to a much lesser extent, or not at all, to other farm products. Five of these economic advantages stand out in bold relief.

1. To direct the production, processing, and distribution of a product, so as to provide the required supply to meet the demands of specific market outlets. This avoids alternate gluts or starvation of a market.

2. To provide sufficient capital for financing producers in order to assure the economic advantages of large scale operation.

3. To assure quality control of the product through the channel of production and marketing.

4. To provide technical know-how in order to maintain low unit cost of production operations, reduce losses (from diseases, insects, and the like), and to encourage the adoption of innovations.

5. To alter the market structure through the by-passing of one or more established marketing agencies. This may come from the retailer and move toward production sources—as in the case of chain food stores—or it could be control from the area of production through farmer-owned and controlled cooperatives moving toward the area of consumption.

These five advantages can be summarized into one sentence: the five

economic advantages of vertical integration (applied to the broiler industry) include control of supply, financing, maintaining quality control, providing know-how, and changing market structure.

In the broiler industry, control is generally centered in the feed supplier who supplies most of the funds for operation, although in some instances it is centered with the processor, the grower, or the retail distributor.

It is to be remembered that the broiler industry has been, and still is, in a class by itself with respect to the rate of production increase, and has had to face all the problems associated with a new, fast-growing, enterprise. No other industry, in all history of American agriculture, has increased as rapidly as has broiler numbers. At the end of World War II in 1945, we produced only 1 billion pounds of broilers compared with 4.7 billion pounds in 1957—a 470 per cent increase in 12 years.

Many broiler growers who saw possibilities in the business had neither finance nor know-how to start an operation large enough to be successful. Nor were they able to obtain a line of credit through the regularly established credit agencies. Feed suppliers also recognized the financial possibilities and offered to provide funds under the condition that they would have reasonable assurance against serious financial loss. This meant that they financed the operations, obtained a certain control in production, and marketing of the birds. Thus, integration was substantially complete with the feed supplier as the integrator. Through the years integrators have facilitated the rapid movement of resources into the industry, absorbed the risks of production hazards and to an extent the price fluctuations. Growers were assured of at least a reasonable wage. That is, reasonable on the basis of their alternatives, but they yielded the possibilities of large profits.

In the broiler business under a vertically integrated arrangement each operation can mesh with the other to the mutual advantage of all parties of the over-all operation. The processor can adjust his operations to his market outlet so as to avoid possible alternate market shortages and gluts. Growers can adjust their production so the processor can obtain a uniform flow of birds to fit his market needs. Likewise the feed supplier can foretell his future needs for supplies of feed ingredients. Thus, in brief, vertical integration has been the means of linking together the production operations from the grower to the final market in a way which has helped make for efficiency and low unit cost throughout every step of the industry.

What is the likelihood that vertical integration, so firmly implanted in the broiler industry, will be transplanted to other phases of agriculture such as livestock (cattle, hogs, and sheep), or dairying?

Among these kinds of livestock so-called "pig hatcheries" have shown

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the greatest tendency toward vertical integration. Here the weaner pigs are produced on a mass production basis and sold to individual farmers at weaning time. The feed supplier, the pig hatchery, and the farmer buying the weaner pigs often work under a contract arrangement—generally with the feed supplier as the integrator.

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In this kind of operation at least two of the five economic advantages of integration mentioned earlier apply effectively—the providing of finance and the supplying of know-how.

While noticeable growth in operations of pig hatcheries can be expected, it will probably not be spectacular. A majority of the well-established, large hog producers will prefer to keep their own brood sows and raise their pigs from birth rather than to purchase them as weaner pigs. The large, well-established farmers are generally quite efficient, are not in need of finance, nor are they suffering from lack of know-how, hence would presumably gain little by vertical integration. In range cattle and sheep production the situation is somewhat similar.

An important consideration in integration is farmers' reluctance to yield control of their operations. Although many farmers have worked as groups through their cooperatives, and in recent years under government production control programs, they have long cherished the traditional freedom of making their own management and marketing decisions. It is hardly to be expected that they will surrender that freedom unless it is distinctly to their economic advantage to do so. Broiler and turkey growers, and to a lesser extent growers of vegetables and fruits, have had limited choice. To many of them the alternative was to integrate or starve—hardly what we could term a practical choice.

Producers of livestock and grains are in an entirely different position. Their enterprises are well stabilized and for the most part operated with relatively high efficiency. Not enough would be gained by vertical integration to warrant a rapid change in that direction at least for the time being.

In the production of beef, hogs (aside from feeder pigs), sheep, dairy products, and the grains, we should expect changes to come more in larger volume of operation per farm than in vertical integration. Increased volume reflects itself in the economies of scale resulting from innovations which are being developed and put into operation at a rapid rate.

Automation for field work and chores on livestock farms is rapidly replacing high cost labor. The hay baler and loader, the silage cutter with loader and unloader attachments are becoming more and more common on all large livestock and dairy farms. Mechanical silage and grain-feed conveyors, which places feed in front of the animals are finding their way to the larger farms where they can be used efficiently and at low unit cost. Labor saving milking parlors and bulk milk handling tanks are

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rapidly increasing on our dairy farms. Push button operation has come of age! It should be emphasized that this type of automation is forcing a trend toward larger farm operations—bigness—not necessarily toward vertical integration.

Perhaps still more important for these products the processing and marketing structures have become quite firmly established and the services are being carried on with a relatively high degree of efficiency—the same as is true of the farm production just mentioned—Hence, for these kinds of livestock and for grains, we should hardly expect to see vertical integration becoming a pronounced factor in the foreseeable future. None of the five basic advantages of integration—with the possible exception of changes in market structure—are sufficiently fundamental to bring about a rapid trend in that direction.

Even though numerous articles have been published in farm magazines and elsewhere showing instances of integration in various farming and marketing operations, they center attention chiefly on individual cases, many of which have not lived long enough to undergo a real test. There is as yet little convincing evidence that they are forerunners of a general trend toward vertical integration.

The federal agricultural control programs have had the effect of disturbing the principle of comparative advantage in agriculture. Areas which have traditionally produced certain crops or kinds of livestock have either supplemented their established type of farming with a new enterprise or have discontinued their established enterprise and have takn on an entirely new enterprise. This has usually required financing which could be obtained most conveniently through a contract associated with an integrated operation. Under such arrangements the integrator not only provides finance but usually know-how and also exercises certain quality controls—the functions which make for advantages of an integrated operation.

Largely because of production control programs, contract growing of hogs—a partially integrated type of operation—is getting a start in some of the southern states. Based upon the principle of comparative advantage, we should hardly expect to see large numbers of hogs raised in the South, out of the corn belt area.

It still remains to be seen how important a factor it will become in the decade ahead. It may well be that the number of hogs produced in the South will not become a pronounced factor nationally, even with the encouragement of agriculture control programs. The growth of a farm enterprise under vertical integration in any area will depend upon the extent to which farmers are bereft of other alternatives.

Certain sociological factors that we generally refer to as the human

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element will serve as a deterrent to integration of an enterprise being started in a new area. As an example, a cotton or tobacco farmer does not become a successful hog producer or dairyman overnight even when he is provided with financial aid, know-how, and other assistance from the integrator. There is much truth to the statement made by a noted farm manager that it takes two generations to make a successful hog producer and three generations to develop an outstanding dairyman.

In summary, it is thus important to recognize that for many agricultural products, the forces stimulating vertical integration and those retarding it may be about evenly balanced.

A vast amount of eye-catching publicity has featured many of the ventures of integration. But little has been said of their continued success or of their failures. It is typical of an operation of this nature to blossom out in fanfare and publicity but it may gradually fade away in complete silence except for the morbid sound of taps. To cite a single example, an ambitious integrated egg-producing and marketing operation centered in the Great Plains was started two years ago with wide publicity, but ended in disappointment after only 15 months.

It appears, however, that out of the venture will develop a somewhat different type of operation, one which will capitalize on the advantage of the economies of scale rather than the presumed advantage of vertical integration featuring a contract between the parties involved.

All in all, the situation with respect to the rate of change toward vertical integration is confused and in a state of flux. Before we can appraise the continued success of vertical integration in its various forms, and with various farm products we will need the results of carefully prepared analytical studies covering a period of several years for several products.

# SOME FUNDAMENTAL PROBLEMS CONCERNING UNDERGRADUATE CURRICULUM IN AGRICULTURAL ECONOMICS

E. J. R. BOOTH Oklahoma State University

## The Purpose of Higher Education

THE major problems of undergraduate curriculum in agricultural economics seem to be fourfold. First, there is little consensus among members of the agricultural economics profession on the purpose of higher education in general. We are not agreed, for instance, on the kind, amount and timing of liberal arts training to which all students, including those in the applied sciences, should be exposed. We are not even agreed that we should insist on any basic course requirements—often preferring to leave to the student most decisions on curricula. Consider the ideas expressed by Allen Tate in a lecture to University of Minnesota freshmen as follows:

"The purpose of education is . . ., at once, the discipline of the mind for the vocations of life and the cultivation of the mind for its own sake; these ends are to be achieved through the mastery of fundamental subjects which cluster around language and number, the two chief instruments by which man knows himself and understands his relation to the world."

If this be accepted, all students would acquire the same foundation of language, logic, mathematics, and history of the world and in particular the United States. The student would still freely choose to go to college, but his university would specify his freshman year studies.

## Variation in High School Training

The second set of problems concern the immense variability in high school preparation of students entering college, variability in subjects required by high schools, in college matriculation requirements, in the range of subjects offered and in the level at which they are taught. The variation assumes special importance in many publicly supported colleges where admission cannot legally be refused to any graduate of a state high school. This difficulty is being overcome in some states by admitting all students but not necessarily to the large university of the state which has high matriculation standards. In other states, with only one or two publicly supported four-year colleges, admission is liberal but matriculation into the college curriculum requires either specified high school preparation or college preparatory courses, for no credit, and at increased fees per hour in some cases.

To illustrate this variation as it affects majors in agricultural economics, minimum requirements of 14 selected land grant institutions are enlightening. The subjects used for comparison are English, social science, and mathematics, as illustrated by Table 1.

TABLE 1.

Credit Hours<sup>a</sup>

1-5 6-10 11-15 16-20 21-25

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Table 1. The Distribution of Fourteen Selected Land-Grant Colleges of Agricul-TURE BY MINIMUM REQUIREMENTS OF ENGLISH, SOCIAL SCIENCE AND MATHEMATICS FOR GRADUATION WITH A MAJOR IN AGRICULTURAL ECONOMICS, 1958

Credit	English <sup>b</sup>			Soc	ial Scien	ncec	$Mathematics^d$				
Hours <sup>a</sup>	Matric.	Lower	Upper	Matric.	Lower	Upper	Matric.	Lower	Upper	Final	
	e	f	g	e	f	g	e	f	g	h	
0	2	_	_	6	2	2	3	1		2	
1-5	1	-	-	5	4	3	2	8	5	5	
6-10	_	11	8	3	6	3	8	5	8	1	
11-15	10	3	6	_	1	3		-		4	
16-20	1	-	_	-	1	3	1	_		1	
21-25		-		-		****	-	_	1	1	

Source: Catalogs for academic years 1957-59 from colleges of agriculture of University of Arkansas, University of California (Berkeley), Cornell University, Florida University, Iowa State College, \*Kansas State College, Michigan State University, Mississippi State College, Ohio State University, \*Oklahoma State University, Oregon State College, \*University of Tennessee, Virginia Polytechnic Institute, \*University of Wisconsin.\*

\*Equivalent semester credit hours with quarter credits counting two thirds.

Including Composition, Literature, Communication, Speech and Journalism.

Including History, Government, Politics, Psychology, Sociology and some Humanities.

Not including Agricultural Economics, Economics or Applied Sociology.

d Including 8th grade arithmetic and up. Not including Statistics.

<sup>e</sup>Matriculation to the college curriculum whether taken in high school or in college for no credit, Adjusted to college base by four semester credit hours for each high school unit of four recitation periods for one year.

Minimum requirements for graduation in any option of agricultural economics.

Maximum requirements for such graduation in any option.

<sup>h</sup> Final level of preparation for minimum requirements in mathematics with levels weighted as follows: 0, 8th grade arithmetic with application to agriculture; 3, intermediate algebra; 8, plane geometry, trigonometry and intermediate algebra; 13, college algebra; 18, analytical geometry and algebra; 23, introductory calculus.

\* Asterisks denoting institutions with quarter system.

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It appears that variation in matriculation levels is only in part compensated by an inverse variation in graduation requirements. This is especially true in mathematics. In one half of the departments selected, a student can graduate with intermediate (high school) algebra as his final level of preparation in mathematics. In two cases, eighth grade arithmetic will do. Two departments do require introductory calculus for their professional option, but only one requires it for all graduates. Students are usually encouraged to take more mathematics but students left to themselves tend to "minimize pain."

In English, we are doing a little better. Most colleges of agriculture insist on the equivalent of three high school years for matriculation. A typical level of training in the colleges selected is five semester hours of freshman composition and about three hours of "journalistic writing."

<sup>&</sup>lt;sup>1</sup>The departments selected were in colleges of agriculture in land-grant institutions of states where agriculture is an important sector of the local economy. Although some of my favorite schools are missing, there is reasonable geographic coverage, and the list does include many departments of agricultural economics considered leaders in undergraduate instruction. Table 1 contains the list of colleges.

Upper and lower level requirements are identical in all but three sample departments.

In social sciences, the matriculation requirements are, perhaps properly, low. But college requirements are also quite low. It is surprising that over half the departments selected only require two courses or less in a social science other than our own, and these are usually state requirements in history. There is greater variation in the level of requirements for social sciences than for English or mathematics with five departments insisting on at least four college courses in their professional option.

Setting higher university-wide matriculation standards would help to solve many problems of curriculum. It would ensure that no section of the university competes for the more poorly prepared students. It would encourage high schools to offer, and students to accept, better preparation in the fundamental subjects of education. And, most important, it would enable all departments to build their curricula on a more secure foundation.

#### Institutional Restrictions

The third problem finds agricultural economics, primarily a social science, somewhat lost in colleges of applied agricultural science. It happens that most of our departments are in the colleges of agriculture of land grant institutions where departments of applied science are in the majority. This majority has been able to require for all students not only physics, chemistry, botany, and zoology, but also a conglomerate of applied lower division courses in animal and plant sciences with a very slight seasoning of the humanities and social sciences. Now first, it has always seemed to me ridiculous to teach applied science or applied economics before teaching the science or the economics. And yet this is what we do in too many colleges of agriculture. Secondly, we have been prone to teach these applied courses to freshmen and sophomores, and the principles courses to sophomores and juniors, before they have had much training in the fundamental tools of learning mentioned before. The Morrill act surely did not intend land-grant institutions to supplant education in fundamentals and principles but to add to it an American dimension of usefulness:

"... the leading object shall be, without excluding other scientific and classical studies, ... to teach such branches of learning as are related to agriculture (and the mechanic arts), ... in order to promote (the) liberal and practical education ... in the several pursuits and professions in life." 2

In practice, this has been interpreted to mean that some students have a liberal education but most are allowed to graduate with a preponderance of applied courses in haphazard sequence. And yet as scientists, we must

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<sup>&</sup>lt;sup>3</sup> U. S. Congress, Statutes at Large, Vol. XII, 37:2, Boston: Little Brown and Co. 1863, p. 504. Emphasis supplied.

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believe that it is more efficient and more useful to teach the general principle before the special application.

Recently, some progress has been made. In my own college, the proportion of applied science required in the lower division of the college of agriculture has dropped from one-third to one-fifth in the period 1910 to 1958. The number of credit hours<sup>3</sup> in elective courses has increased from none to 15 leaving that much leeway for the special requirements of individual departments. The increase has been effected, however, mainly at the expense of a reduction of 20 hours of college rquirements in English and mathematics. The typical college of agriculture still requires in the lower division nearly half of students' time to be spent in the natural and applied sciences. The remaining half is split about evenly between departmental requirements and a residual for mathematics, English and military science.

I would recommend that the sophomore year be devoted mainly to college requirements in principles of science useful to agriculture and in a continuation of training in the instruments of learning; language and number. These principles would include an agricultural economics semester course in the economic history and the problems of American agriculture. They would include such courses as physics, botany and zoology but no "farm shop," "field crops," "types of livestock" or "farm management" before the underlying principles of these applied courses are at least partially understood by the students. Institutionally, this would require college-wide agreement, not yet evident, on the purpose of college training. It would require, for instance, that curricula in colleges of agriculture become less a continuation of high school vocational agriculture; and that includes curriculum in agricultural economics. The student, once again, would freely choose his college at the end of one year but the faculty would determine the majority of the courses to be taken.

## Diversity of Training Goals in Agricultural Economics

The last set of problems considered here concerns the diversity of our own training goals. It appears that many departments of agricultural economics now recognize this diversity by offering formal "options" within the major. The options help to advertize the varied types of training offered in our field, by emphasizing the wide-spread influence of agriculture on the whole economy and *vice-versa*: agribusiness and all that. This

<sup>&</sup>lt;sup>1</sup>Semester course credits reckoned on the basis of one hour for each hour of lecture or two hours of laboratory for one-half of the academic year.

<sup>&</sup>lt;sup>4</sup>Professor Brinegar has given some necessary reasons for the order of this process of teaching applied economics. A further, and perhaps sufficient reason would be that economic history provides a sense of the problems to be attacked. See, George K. Brinegar, "Teaching Economics in Colleges and Universities," Journal of Farm Economics, November, 1956.

is a by-product not to be dismissed lightly in this period of declining enrollments in agriculture. But mainly, these options have helped to reorganize curricula in agricultural economics in a formal manner to provide specialized training to meet special objectives. Of the 14 departments of agricultural economics studied, eight offer two options or more. Six offer specialized training in farm management, eight in marketing and business, three in public service and administration and two offer both agricultural marketing and agricultural business as separate options.

The problem of diversity of aims is being faced by other departments

as fields become more capable of specialization.

At Oklahoma State University, for example, over one-half of the departments offer more than one option within their major. Exactly one-half include a "business option" which is serviced by courses in agricultural economics and business. Servicing these options has become another aim of departments of agricultural economics. It is to be hoped that our lower division applied courses be used only for this objective, and not required for our own majors.

It seems to me that a student should not specialize in any option of agricultural economics until the final year. The principles underlying the applied training in these options are common to all. Junior year might better consist of courses in logic, the scientific method, mathematics and economic analysis at the firm and economy level. One analytical course each in farm management and agricultural marketing for all our majors, well founded on such fundamental preparation, could probe these subjects more deeply and more usefully in two semester courses than is often done presently in six. Final year would be, in this utopia, an efficient specialization into the diverse fields of agricultural economics.

There is criticism of these propositions on the grounds they interfere with the freedom of choice of individual students. But they would allow a student to make a much freer choice of his own ends of education by postponing the decision of specialization as long as possible. The means by which these ends may best be reached, namely curricula, would become the fit province of his teachers. By similar reasoning, the number of elective courses should increase only as a student becomes better trained

to make a choice of means.

More agreement is needed on the principles of education in agricultural economics and in other applied agricultural sciences before the details of curricula revisions are ironed out. Piecemeal will not do. The conclusion here is that the major problems related to undergraduate curriculum in agricultural economics will be amenable to final solution only when such agreement is more evident at the university, at the college, and at the department levels.

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## A METAPHYSICAL HYPOTHESIS\*

A. N. HALTER University of Kentucky

THE general objective of this paper is to state an hypothesis. This necessitates defining three particular words. The first word is science, meaning that type of mental activity which satisfies the following two conditions: (1) there must be orderly or systematic thinking and

(2) there must be a definite subject-matter.

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The second word is presupposition, referring to the context in which a true or false proposition is stated. Presupposing is assuming (consciously or unconsciously) conditions necessary if the desired result is to be derived. An absolute presupposition is never subject to the question of truth or falsity as is a proposition. Science uses presuppositions as a basis for the derivation of logical effects and power to produce these logical effects does not depend upon the verifiability of the presuppositions.

The third word is metaphysics, meaning here the discipline which concems itself with the presuppositions underlying science. Metaphysics is an historical science in that its subject matter is the absolute presupposi-

tions that have been made on certain past occasions.1

Specifically the objective of this paper is to state a metaphysical hypothesis concerning the presuppositions of agricultural economics. It will be an historical statement of absolute presuppositions which have been and/or are being used by the "students" of agricultural economics. This hypothesis, just as any other, must meet the criterion of testability, ie, it must be possible to specify the methods that one could use in substantiating or refuting the hypothesis. Verification of the hypothesis has important implications for the methods of research used in agricultural economics. A reference to social sciences is justified since agricultural economics is only one specific application of social science.

As a dialectic example of the exposure of a presupposition, suppose for a moment that we were to confront an agricultural economist with the

<sup>1</sup>Metaphysics is also defined as the science of pure being. This definition connotes an impossibility. A science of pure being is as impossible as a science of ideals or morals, c.f., R. G. Collingwood, An Essay on Metaphysics, Oxford: Clarendon Press,

In 1955, Karl Brandt pointed out to the American Farm Economics Association meeting that a study of philosophy would lend clarity to our understanding of the nature of economics and to its research methods. c.f. Karl Brandt, "The Orientation of Agricultural Economics," Journal of Farm Economics, December, 1955. This reference to philosophy has gone unnoticed. No papers in the Journal of Farm Economics show evidence of anyone having taken up his challenge. The theme of the conference this year would lead one to suspect that philosophy of science might have found a place in the program.

question, "What is the cause of technological change in agriculture?" He might give you such quick responses as "institutional forces," "cost economies," "efficiency of capital," or "management." You might then be so brazen that you would ask, "I supposed you are quite sure it has a cause?" To which our agricultural economist might reply, "Quite sure, of course." If you now ask, "Why?" he will probably answer, "Everything that happens has a cause." If you are a metaphysical opportunist you ask, "But how do you know that everything that happens has a cause?" In answering this one the agricultural economist would probably throw a proceedings issue of the *Journal of Farm Economics* in your face, because you have put your finger on one of his absolute presuppositions and people are very explosive about these.

## Statement of the Hypothesis

The metaphysical bypothesis to be elaborated in this discussion is this: In the writings of agricultural economists there exists a fundamental confusion concerning the idea of causation, i.e. lack of clarity from the beginning. There are at least two and possibly three senses in which the word "cause" is actually used in agricultural economics and all three may be used on the same occasion (i.e., in the same piece of literature).

The first sense of cause is that motive from which a free and deliberate act is the outcome. In this sense causing means affording a conscious and responsible being a motive for doing the act. This is the historical sense of causation and it can be found in writings where an historical explana-

tion of some event is attempted.

The second sense of causation is probably the one most agricultural economists would like to use. It is the practical sense in that an event (or state of things) can be produced or prevented. This is also the sense in which the word "cause" is used in nonsocial engineering and medicine. The social sciences as well as agricultural economics probably borrowed this sense from the natural sciences but extended it to their entire subject matter, i.e., presupposed that there is no social event without a "cause."

If this aping of the methods and vocabulary of engineering and medicine by the social sciences is as extensive as here implied, then it will be impossible to find "cause" used in the *third* sense. The one-to-one causal relation between events implied by sense three must satisfy the conditions (1) if the cause exists, then the effect must happen; (2) if the effect exists, then the cause happened prior to the discovery of the effect. This is the theoretical use of cause and refers to events that happen independently of human action. This is the sense in which the word has traditionally been used in physics and chemistry and in general in the theoretical sciences of nature.

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## Implications for Research Methods

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The implications for methodology in agricultural economics parallel the presupposing of one of these senses of the word "cause." If one presupposes the first sense of cause, then his methods will be designed to discover man's intentions to act in the way in which he acts. Methods of research in this area are still crude.

Experimentation is the method that would be commensurate with the presupposing of the second sense of cause. Through experimentation the researcher discovers those variables which he can control. No amount of observation of current events will serve to establish a proposition that presupposes cause in the second sense. By observing and thinking, one may form opinions about causes but he cannot acquire knowledge except by experimental methods. While this sense may be the most desired in agricultural economics, we would find very little methodology used that could be described as experimental, i.e., where the variables that produce the desired effect are under the control of the experimenter. If we attempted to test the hypothesis of this paper, we would find the second sense used interchangeably with the first sense in the literature describing the methods and objectives of agricultural economics.

Although it is here practically denied that agricultural economists use the word "cause" in the third sense, it might be going under various aliases. One of these assumed names is functional relation and another is structural analysis.

In the writings of agricultural economists the words "functional relation" could be found and if the writer of these words were questioned, he would probably tell us that he means the logical connection between a thing's function and its behavior, i.e., if the function (cause) is given, the behavior (effect) will follow. He might go so far as to tell you that the finding of some particular function would necessitate your finding the effect. A similar situation with respect to the use of the words "structural analysis" could, no doubt, be found.

While the renaming of a presupposition may make us think we have a new product, it is only the old product going under a new label. However flashy the label, it should be recognized that the product is still the presupposition of cause in the third sense.

To support defiance of this third sense of cause, note it is fraught with difficulties,2 and modern physics3 has replaced this sense with the presupposition that some classes of events happen according to law. Because the presupposition of law is not used in social sciences, and in particular agricultural economics, an illustrative example is not available. However, an

<sup>&</sup>lt;sup>1</sup>B. G. Collingwood, op. cit., pp. 313-327.

<sup>1</sup>By modern physics I mean the physics since the time of Newton.

example such as the Newtonian laws of motion from physics<sup>4</sup> may serve to demonstrate the consequences for methodology in the social sciences. There are two features that describe methods used to discover and verify laws: (1) they are theoretical and (2) they use as their criterion of verifiability prediction of events either past, present or future. Mathematics is an indispensable methodological tool of physics and would also be indispensable in social science methodology if the presupposition of laws were adopted. I agree with Karl Brandt that the use of mathematics in agricultural economics has served no genuine purpose.<sup>5</sup> I believe it has been used more often as a disguise for no data and/or prejudgements concerning the nature of man<sup>6</sup> rather than as a source of theoretical relationships between social events and as common language for scientists.

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The spectacular accomplishments of nonsocial engineering where cause is taken in the second sense and its dependence upon the results of theoretical physics where there is no notion of cause has been referred to many times. But what is rarely mentioned in social engineering is the complete lack of a theoretical "socialics." There is no argument other than (1) the failure of social engineering and (2) analogy to the physical sciences that there must be a dependence between the results of social engineering and "socialics." Since a metaphysical study can only show what presuppositions are used or not used, it cannot predict that the adoption of certain presuppositions in social science will be more productive of results than those that are now used. However, the enumeration of the presuppositions that are used will contrast those of the social sciences with those of the physical sciences. Those that will be productive of results and adopted by social science can only be found by trying them out.

#### Conclusion

An attempt has here been made to show that a metaphysical study of agricultural economics (and in general social science) would result in uncovering of some methodological entanglements. The hypothesis if verified would show that entanglements are largely due to the admixture of the three senses of the word "cause." A comparison with the physical sciences would show the inefficiency of present presuppositions and the absence of others, probably more efficient, in the social sciences.

 $<sup>^4</sup>$  Or, Galileo's law for freely falling bodies:  $d = 16 t^2$ . It does not make sense to say the time t is the "cause" of the distance.

<sup>&</sup>lt;sup>8</sup> Karl Brandt, op. cit., pp. 796-800.

<sup>9</sup> For example, since calculus provides the rules for maximization, man is assumed to be a "moral maximizer."

<sup>&</sup>lt;sup>7</sup> A practitioner of "socialics" might be called a "societician." These words are intended to emphasize the contrast and not to suggest a convention.

## SOME OBSTACLES IN THE PATH OF PROGRESS IN MARKETING EXTENSION WORK

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DALE E. BUTZ
Michigan State University

It is generally supposed that the solution of problems leads to progress. If this be true, the opportunities for progress in marketing extension work ought to be tremendous. The real question evolves around how well we meet some of the obstacles and challenges that seem to be holding us back. Time and space will not permit a detailed discussion of all the many facets of our trials and tribulations, but a few of the more significant ones can be hauled out for closer scrutinizing. The suggested remedies to be presented later in this paper are not to be taken as examples of what ought to be done. In most cases the solutions are suggested for discussion purposes only. This has the advantage of leaving the listener or reader free to suggest his own solution without necessarily disagreeing with the author.

In the first place many marketing extension workers aren't quite sure what the objective of their work really is. If they are explaining their work to farmers, they are probably trying to increase farm income. When marketing agencies appear on the horizon, the extension workers find that they are trying to make the agencies more money. If by chance a poor consumer turns up, the extension personnel have something for her too in the form of more value for the same or less monetary expenditure. If the extension workers are in doubt of the make-up of the audience, they may hide behind the catch-all objective of trying to "improve the effici-

ency of marketing."

The above objectives are each laudable in their own right, but a mistake is made in thinking that all three of four horses can be ridden at the same time. Occasionally they may be going together but more often the paths tend to diverge. At this point a decision must be made as to which horse to ride. Most marketing extension personnel were born and reared on the farm and have a deep-seated interest in what happens on the farm and to farmers. Also the sources of funds are usually tied closely to a fairly narrow definition of agriculture. For these reasons and many more there is a tendency to ride with the farmers when the horses begin to part. This is a perfectly legitimate decision, but the extension workers ought to recognize what they are doing and the limitations that such decisions place on work with marketing firms and with consumers.

The problem of conflict of interests is further amplified by the fact that our undergraduate and graduate students are trained as if they were going to work directly on the farm or closely with farmers. Our professors

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insist that the students know location of production areas, how, when, where and what to sell, marketing channels, pricing and price variation, and a host of other pearls of wisdom that are basically farm or local market oriented. There is nothing wrong with this kind of training, as long as the students are really being prepared to take advantage of the opportunities available to them when they graduate. The fact that many extension services as well as agricultural businesses have looked more and more toward schools of business for replacement personnel in recent years may raise serious questions about the adequacy of the training given many students. In some cases marketing firms are willing to retrain personnel in order to get someone with an agricultural background. More often, however, capable people are passed over because of their background and training.

All of this suggests a closer coordination and correlation between the offerings of departments of agricultural economics and schools of business. At many institutions this is taking place at the undergraduate level. Progress at the graduate levels seem to be somewhat slower with each side apparently unwilling to give up enough required courses so that the poor student can get a degree in much less time than the equivalent of an M. S. and an M. B. A. combined.

From the extension standpoint, particularly in regard to work with marketing firms, it might be desirable to administer the work through the department of marketing in the school of business. At the same time a question could be raised as to whether or not such work ought to be carried on for free as is done in the traditional agricultural extension service. Perhaps a realistic assessment of the benefits will suggest that such organizations rightfully ought to pay part or all of the expenses and not assess the charges to the taxpayers in general.

Such arrangements ought to place the work in the hands of people trained to do the job. In addition, they probably wouldn't enter the job with the customary farm bias of present workers. There are many reasons why the above suggestions are unworkable and impracticable, but they deserve serious consideration.

Another serious limitation to work with marketing firms is lack of practical experience. Since there is no real good substitute for experience, this suggests that our graduates ought to be encouraged to take jobs in industry before being hired on extension. This sounds good in theory, but difficult to do in practice. One of the more difficult problems faced by the extention service is that of having a high enough salary scale to attract a competent person with business experience. Occasionally someone can be found who is willing to take a pay cut for the security and other things connected with college life. This is the exception rather than the rule. Pos-

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sibly some scheme can be worked out whereby graduates serve an apprenticeship with business firms with the college picking up a part of the tab under the heading of professional development. Maybe the colleges, universities, and extension services will have to raise their salary sights when hiring people with business experience to do marketing extension work. Some of this experience can be picked up through close contact and work with marketing firms. In general, however, this is a slow, tedious way in which to assimilate it.

Another problem that arises in doing marketing extension work is the conflict between the concepts of education and service. In theory the extension specialists are educators and ought to outline the principles so that the clientele can make the application to their own particular problems. In actual practice the marketing firms many times find it hard to make the application without detailed assistance from the extension representative. As marketing firms get larger and take on their own research staff, this problem may be somewhat lessened. In the meantime, however, there will necessarily have to be a substantial amount of service-type work individual firms or small groups of firms. Success in working with individual firms is essential in terms of building clientele that later may be educated chock-full of useful principles. A question may be raised as to whether or not an intensive job well done with one or a few firms may not yield greater results many times than a buckshot coverage of many firms that falls far short of the target. It goes without saying, however, that to be successful the intensive service-type approach requires the full understanding of administrators who may consciously or unconsciously be judging results by the number of people contacted.

With all due respect to those engaged in research it can be safely said that for the solution of many of the problems faced by extension marketing personnel, adequate research does not exist. This raises the thorny problem of who should do the research. Should it be done by the labeled researcher with assistance from the extension man? Or should the extension person keep his "cotton-picking" hands off until the researcher dumps the results to him in a package? Possibly the extension worker ought to strike off on his own with or without assistance from his colleague in research.

Indeed, more and more it seems that if marketing extension personnel are to have the data they need to solve many current problems, they will have to get the data themselves. This is in no way meant as a criticism of research personnel, but only a statement of what seems to be the most expeditious way to solve the problem. Certainly they should consult with their researchers in the planning and executing of the study. This, in turn, will free the researchers to work on more basic long-term problems. This

type of an approach to solving this problem requires among other things, (1) competent extension personnel and (2) an understanding among extension administrators that extension people are engaged in problem solv. ing research. Perhaps a time limit of say one year or some other designation ought to be placed on projects in order to keep extension workers from becoming too deeply involved in research while being paid on extension funds. This problem can be worked out if administrators understand and are sympathetic to the problem.

There is one last item to consider. Assume that the problems of objectives, academic training, organization, experience, and research are solved. What good is all of this unless we have an effective man on the firing line—a teacher? Unfortunately, many of our personnel come to us with little or no experience along the line of communications—either written or oral. It is probably too much to hope for changes in the training program which will plug up this hole. This means that a considerable amount of time must be spent in training along the lines of communications in order to improve teaching effectiveness. This is a hurdle that few people get over completely. It's a job that is never-ending and few people even reach the upper limits of their capacity. Communication training is difficult to do since many people in extension assume that originally or certainly after a little experience they are professionals. Unfortunately, in too many instances, such is not the case.

These are only a few of the serious limitations or obstacles facing marketing extension work, but their solution would enable the judges of marketing extension work to have a better insight into real possibilities within the marketing extension arena.

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### THE LAND GRANT COLLEGE OBLIGATION

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EBER ELDRIDGE Iowa State College

ABOUT 23,600 land grant college employees use \$128 million in extension work and \$113 million in research work to effectively discover and disseminate information. This is part of the land grant college system in the United States. The very fact that this system continues to receive regular appropriations is testimony to its unquestionable success.

The extension service is the youngest of the three phases; teaching, research, and extension, in the land grant colleges. This organized network of county and state educators has a potential influence that has no equal in the world. Many foreign visitors have pointed to this system as the significant key to our agricultural productivity.

Although the land grant system has a wide range of activities, its major efforts have been directed toward the adoption of new and improved technology. The success of this endeavor is obvious. In 1803 the productivity per farmer was enough for three consumers. Today's mechanized, scientific agriculturist produces for more than 20 people.

For the first half century of the land grant college's life this single focus was correct. It might still be correct, but it is no longer sufficient! During that first half century incomes of consumers were low, income elasticities were high. With a small industrial product and a small labor force, the minimization of labor inputs in agriculture was necessary to allow for growth in the nonfarm economy.

This general condition has not prevailed in the last few decades. The land grant college must re-examine its objectives because: (1) it is not benefiting farm income. (2) it is not encouraging agriculture's full contribution to economic growth. (3) it is permitting a distrust for new agricultural technology to develop that could endanger the land grant college's future and curtail economic growth.

## Improving Farm Income

Most extension workers believe they are working to improve the farmers' income. This has not been their only objective but it has been, and still is, an important one.

The extension worker has had good reason to believe that this objective was being fulfilled. He has worked with many innovators to establish a new technique in a specific area. The improvement in the "innovators" short-run income and the increase in productivity which followed seemed to be ample proof that farm income was being improved.

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Economists have been saying to each other for many years that most agricultural technology has been output increasing, capital using, and labor saving. With the low income and price elasticities of agricultural products this technology will reduce aggregate gross farm income. The per capita farm income must decline unless resources are transferred out of agriculture.

Unfortunately, this well accepted economic principle has been "well accepted" only in groups of economists. Even today the majority of land grant college workers do not fully appreciate the meaning of this economic principle.

Some economists have not recognized that a significant income transfer from the farm economy to the nonfarm economy has been taking place. The decrease in market price resulting from output-increasing technology has been far greater than the decrease in cost of production. After the output increase the nonfarm consumer could buy the same quantity of food as before and still have money left over for other purchases. The farmer could buy *less* than before. Who can honestly say that our land grant colleges are helping farm income?

It is easy to point an accusing finger at the technical specialist, but economists must share the blame. They have not been effective in educating their colleagues nor the general public regarding the effect of increasing output with low price elasticity.

Secondly, farm management economists have been perhaps more effective than the technology specialists in increasing farm output. The traditional farm management approach of maximizing output with the land resource considered "given" has not been conducive to resource reallocation. The increased productivity from a new technique can be taken as (1) more farm output or (2) with reallocation of resources, as more non-farm output. The traditional farm management approach has encouraged the former.

Obviously, the effects of farm output technology have been little understood.

## Promoting Economic Growth

The most significant contribution of the land grant college has been its effectiveness in promoting economic growth. The agricultural output has grown rapidly. Additional per capita output has meant additional real income for the country—and a higher level of living.

But the land grant college has not encouraged agriculture to make its fullest contribution to economic growth. For the full impact of technical innovations in agriculture to be realized in economic growth the adjustment of resources to these innovations must also take place.

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nical ljustHere again, economists have not communicated their knowledge that (1) the increase in aggregate output and (2) the increase in the relative productivity of capital to labor, has caused farm labor to become highly redundant. Farm prices have clearly demonstrated a structural maladjustment in our economy. Consumers are saying (through the proper functioning of the price mechanism) that too many resources (especially labor—and in many areas, capital) are being used in producing food.

In order to achieve full economic growth the goals of the land grant colleges should be: (1) to free a maximum of resources from agricultural production to be used in the nonfarm economy. (2) to facilitate the movement of these resources from farm to nonfarm activities.<sup>1</sup>

This the economists have known but have not successfully communicated to their co-workers. Concentration on technical innovations particularly on commodities with low price elasticities has tended to "free a maximum of resources from agriculture production."

But, having been freed they were left stranded; bewildered by the ruthless economic forces which descended upon thm. The land grant college is obligated to take the second step and "facilitate the movement of resources from farm to nonfarm activities." This has not been done! The social costs of some of the secondary adjustments might indicate that a "maximum" reallocation of resources is not desirable. Presumably an optimum rate of transfer, combined with consistent government programs, can give an optimum rate of economic growth and still improve factor returns to agriculture so that farmers may share in the benefits of economic growth.

## Preserving an Appreciation for Technological Progress

Although economists have failed to communicate knowledge adequately, farmers are beginning to comprehend the income effects of output-increasing technology on commodities with low price elasticities. In the fall of 1956, 20 Iowa farmers asked for a conference with the Iowa state college administrators. In substance these farmers suggested that the college curtail the promotion of new technology since agriculture was suffering from "too much efficiency," and that resources be reallocated to promote agricultural adjustment.

Placing the blame on "too much efficiency" is an idea which could gain momentum among farmers (especially in a period of depressed incomes) and react adversely on the land grant colleges. A widespread movement in this direction could jeopardize the public support of agricultural re-

<sup>&</sup>lt;sup>1</sup>Earl O. Heady, "Adaptation of Extension Education and Auxiliary Aids to the Basic Economic Problem of Agriculture," *Journal of Farm Economics*, February, 1957.

search, including, incidentally economic research, and be significant deterrent to economic growth.

Economists need to effectively communicate their knowledge of economic growth. Farmers need to understand not only the effect of output increasing technology on their income but also that they cannot fully share in the benefits of economic growth unless there is resource reallocation. They need to understand that we don't dare slow down the rate of economic growth. They need to understand that Iowa farmers must continue to improve techniques and efficiency in order to successfully compete with farmers from other states.

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Perhaps our only remaining significant advantage over the USSR is our agricultural productivity. We cannot afford to reverse or retard technological progress in agriculture. The only feasible answer is to have continuing progress and then direct more of our educational resources to the process of facilitating adjustment.

The combined efforts of the land grant colleges, in conjunction with complementary government programs can do this job. By fulfilling their obligations to the nonfarm as well as the farm groups of the United States they can attain their objectives:

- (1) Farmers who remain on the farm would have improved real income.
  - (2) People who leave the farm would have improved real income.
    - (3) Social costs of secondary adjustments would be minimized.
    - (4) Technological progress will continue.
    - (5) The economy would achieve an optimum rate of growth.
- (6) A contribution would be made to maintaining the nation in a position of political and economic world leadership.

There are two questions every group of economists should ask themselves:

- (1) Have we devoted enough of our resources, as economists, to this area?
  - (2) How effectively have we communicated our knowledge?

## MOTIVATING FORCES UNDERLYING INTERMARKET MILK PRICE RELATIONSHIPS

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HERBERT G. SPINDLER University of Massachusetts

THE observations and conclusions here drawn are primarily based on a comparison of milk prices for Boston and five Massachusetts secondary markets for a 20 year period from 1935 through 1954. Price differences were determined on an annual basis for Class II, Class I and blend prices. All prices were for milk of 3.7 per cent butterfat at the respective markets.

The basic objectives were to: (1) determine the amount and pattern of price differences, (2) determine reasons for and effects of price differences, and (3) determine the relationship between actual price differences and location theory price differences as reported by Bredo and Rojko.<sup>1</sup>

Since consumers use roughly one pound of milk per day per person in fluid form and another pound per day in manufactured products, population provides a gauge of market demand. Massachusetts contains about one-half New England's population. Of the 5 million in Massachusetts, almost one-half are located in the Boston milk marketing area, one-fourth are in the five secondaries, and one-fourth in various tertiary markets.

Boston's milkshed is centered in Vermont about 200 miles northwest of Boston. The Worcester and Springfield markets, with populations of 300,000 and 350,000, in 1950, lie 40 and 89 miles west of Boston. Merrimack Valley with 266,000 population, lies 27 miles northwest, and Fall River and New Bedford with populations of 128,000 and 142,000, are located 51 and 56 miles south of Boston.

Prices in the five secondary markets for the twenty years 1935-54 exceeded Boston's by only one cent per hundredweight on Class II or surplus milk, but 12.5 cents on Class I or fluid milk and 56 cents<sup>2</sup> on producer blend prices. What has been the cause and effect of these prices?

Class II prices in the secondaries rarely deviated from Boston's by 25 cents per hundredweight. But an equal proportion of surplus did not result. Secondary market dealers, motivated by their quest to minimize costs, in effect denied Boston producers the opportunity to supply the

<sup>&</sup>lt;sup>1</sup>William Bredo and Anthony Rojko, "Prices and Milksheds of Northeastern Markets," Northeastern Regional Publication No. 9, Amherst: University of Massachusetts, August, 1952.

<sup>&</sup>lt;sup>2</sup>Sixty-three cents if the 46 cents nearby location premium rate is used for Spring-field, Worcester and Merrimack Valley for five years 1950-54. Approximately 60 to 80 per cent of the pool milk for these markets is in the premium zones; in contrast, about 4 per cent of Boston's supply is from premium zone areas. Omission of discussion on nearby location premiums does not change the basic conclusions drawn.

secondaries with a 56 cent higher price. As a result, secondary markets averaged 88 per cent Class I utilization, as compared with 30 points less or 58 per cent for Boston. The proportion Class I for the tertiaries would approach 100 per cent.

Dealers in the secondaries, because producers can apply little economic pressure in their choice of markets, determine the plant to which farm milk is shipped, decide the disposition of such plant supplies and decide

the market in which milk is pooled.

Secondary market Class I prices 22.5 cents higher than Boston's provided an inducement to dealers in secondary markets to purchase lower priced Boston pool milk. To illustrate, Springfield's market price averaged 12 cents over Boston's. A Springfield dealer using Boston pool milk owned such milk 12 cents less than locally purchased milk. Adding 7 cents to adjust market prices for greater proximity to surplus areas raises this differential to 19 cents.<sup>3</sup>

The lower Boston Class I price appears to be a reason why all the secondaries receive supplies, particularly seasonally, out of the Boston pool, even though the Bredo and Rojko study indicate that a self-contained market results in least transportation cost. Possible too, reliance on Boston for fluid supplies for the secondaries also resulted in surpluses

gravitating to the Boston pool.

The proportion surplus is restricted in the secondaries because of higher processing and handling costs than in the up-country specialized manufacturing areas. Even separation to provide cream for routes is likely to be costly, and higher skimmilk values since the war made skim dumpage less practicable. The tertiaries have no manufacturing facilities. A producers' cooperative-manufacturing-outlet is located in or near each of the secondary markets. Even though the cooperative absorbs surplus milk in the market and typically pays the Class II price at its plant, the dealer usually incurs losses on weighing, testing, hauling to the cooperative's plant, and on market administrators' assessment. These higher costs cause higher blend prices for the smaller markets.

The absence of surplus in the secondaries has the commendable tendency to minimize transportation costs. Direct haul transportation rates in Springfield reach 40 to 60 cents. Since there are no manufacturing facilities in its milkshed, transportation costs absorb the value of the skimmilk on a sizable proportion of the surplus hauled to the market for manufacturing. Since 20 cents transportation is typical for country as sembly, 20 to 40 cents transportation cost could be saved if nearest sup-

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<sup>&</sup>lt;sup>a</sup> Bredo and Rojko. Based on May-June, 1948 supply-demand conditions Springfield's location theory price should be 7 cents under Boston, Worcester and Merrimack Valley 3 cents under, and Fall River and New Bedford 4 and 6 cents respectively over Boston.

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Another type of inequality in dealer cost occurs with dealer purchases of fluid milk in competition with the Boston blend, and sale of such unregulated milk in a state regulated market in competition with milk produced within the state on which dealers must pay the local Class I price. Often, such price differences amount to \$.50 to \$1.50. The amount of the difference depends on the price difference and the quantity of milk involved.

Class I price differences between primary markets like Boston and New York provide incentive to dealers in Rhode Island and Connecticut to buy in the market with the lowest Class I price. Increased Class I utilization will enhance the blend, conceivably over the blend in the higher Class I market. Dealer response is to class prices. Producer's quest for the highest available blend price would likely be expressed in movement of producers between Boston and New York plants along the Vermont-New York milkshed boundary if blend price difference became substantial.

While the proportion of Class I effects blend prices, the range between Class I and Class II prices is also a vital factor. To illustrate, assume \$6.00 and \$3.00 class prices and 60 per cent Class I utilization in Boston, but 90 per cent in, say Springfield. The blend price difference is \$.90, computable by multiplying the difference in the percentage Class I (30) times the range between Class I and Class II (\$3.00). Changing the Class I price from \$6.00 to 5.00 decreases the differences in blend prices from \$.90 to \$.60.

The difference between blend prices for Boston and five secondaries was 59 cents in 1937-42, but declined with the decrease in the Class I to Class II differentials in the 1943-46 war shortage period to 44 cents, and again soared to 83 cents in 1947-50. Had an adequate seasonal differential been maintained under Office of Price Administration price ceilings, the Boston to secondary market blend differential would have been much less than 44 cents.

Administrative agencies, subject to possible producer insistence to maintain a high Class I price in the hopes that this will enhance the blend price, control the range by which Class I prices exceed surplus prices. Boston forms the king-pin for Class I pricing in New England. Some markets use Boston's Class I price, others follow it often with fixed differentials.

Through the establishment of the level of Class I prices, the primary market controls the proportion of surplus in New England. An initially high Class I price causes some curtailment in consumption, encourages use of substitutes, and increases production. Low Class I prices encourage consumption and controls production. Increases in the surplus tend to

gravitate to the Boston pool. The tertiaries remain close to a 100 per cent Class I utilization under any circumstances.

A change of \$1.00 in Class I price originating in Boston provides a change in producer returns of as much as \$1.00 in smaller markets, but around \$.60 for Boston. If then, farmers' aggregative productive response is sensitive, a much larger production response will occur in the smaller markets. And if, say a \$4.80 price level would bring forth precisely adequate supplies, then after demand and supply responses to an initially \$.50 higher Class I price re-established the general blend price level at about the original \$4.80 level, the smaller markets would receive most of the \$.50, while Boston's price fell below \$4.80.

Producer requests for federal orders in southeastern Massachusetts and Connecticut are motivated primarily by dealers' opportunity to purchase out-of-state supplies at a price based on the Boston or New York blend. Inequality in dealer cost of product has resulted, and higher priced local

supplies threaten to be priced out of the market.

The weakness in reliance on a relatively high Class I price (high by supply demand standards with 45 per cent Class II in the Boston pool in 1956) is evident. The high level of Class I price initially raises blend prices, production is increased, increased surplus decreases the blend, a widened range between the Boston blend and Class I price results, thereby providing attractive differentials for unregulated supplies to state markets. While the maintenance of Class I prices, which have provided more surplus than required reflects producers attempts to maximize returns, it has also provided an invitation to dealers to seek cheaper sources.

#### Conclusions

Differences in dealer costs to process surplus milk affects the proportion of surplus in a market.

Inequality of dealer costs for fluid milk results from a failure to align prices on fluid milk on a location theory basis. Uneconomic movements of fluid supplies and manufacturing may result. Dealers are motivated by

available opportunities under established class prices.

There is lack of evidence that a high Class I price, over a long-run period or cycle, results in higher blend prices. The fact that federal orders are relying on supply-demand factors, that total and regional U. S. fluid milk production keeps in line with an ever-increasing population without noticeable higher prices provides evidence that significant response in production to prices does occur. Relatively high Class I prices lead to surpluses, widened price differentials and market instability. More economic movements and economic handling of milk may be achieved by giving more attention to dealers' cost reactions to established Class prices.

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## CONCENTRATION OF LAND OWNERSHIP\*

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GENE WUNDERLICH Agricultural Research Service, USDA

THIS paper is devoted to a method of measuring concentration of land ownership. The method, designed to give greater precision to the concept of concentration, is developed from the Lorenz and Gini measures of income distribution. As such, it relies upon a rather particular meaning of concentration, a meaning solely dependent upon distribution of land among owners and totally independent of absolute standards of size or norms of an equitable distribution. The method is illustrated with data on land ownership from the Great Plains States.

Measurement of Concentration by Lorenz Curve and Gini Ratio

Concentration of wealth and income is a well-worked field, the beginnings being attributed to Otto Ammon by Corrado Gini in 1895.¹ It is through the efforts of Gini, Pareto, and Lorenz² that we have most of the foundations of present-day theories and measurement techniques of income distribution. It is from them and their latter-day counterparts³ that the method of measuring the concentration of land ownership in the Great Plains has been drawn.

The Lorenz curve (Fig. 1) consists of a cumulative percentage distribution of arrayed observations on the abscissa plotted against a cumulative percentage distribution of an attribute on the ordinate. The common form

<sup>1</sup>Otto Ammon, Die Gesellschaftsordnung und Ihre Natürlichen Grundlagen. Jena: Fisher, First published in 1895.

<sup>2</sup>The statement of the Gini concentration ratio is attributed by Yntema to Corrado Gini's "Sulla misure della concentrazione e della variabilita dei carattere." Atti del reala Istituto Veneto di scienze, letters ed arti. tome 73, part 2, 1913-14, p. 1209.

See also Gini, On the Measure of Concentration with Special Reference to Income and Wealth. Colo. Coll. Pub. No. 208. 1936. (A Cowles report.) M. O. Lorenz, Methods of Measuring the Concentration of Wealth. Amer. Statis. Assoc. New Series No. 70, June, 1905. Pareto, Vilfredo. Cours d'économie politique. Lausanne. 1897.

<sup>3</sup> A few noteworthy examples are:
Mary J. Bowman, A Graphical Analysis of the Personal Income Distribution in
the United States, In Amer. Econ. Assoc. Readings in the Theory of Income Distribution, Philadelphia: Blakiston, 1946.

Selma Goldsmith, "Statistical Information on the Distribution of Income by Size in the United States." American Economic Review, Vol. 40, No. 2. May, 1950.

Horst Menderhausen, Changes in Income Distribution During the Great Depression. New York, National Bur. of Econ. Res. 1946. Note especially Appendix C. Dwight B. Yntema, "Measures of the Inequality in the Personal Distribution of Wealth or Income," Journal of American Statistical Association, Vol. 28, No. 184, pp. 423-433. December, 1933.

<sup>&</sup>lt;sup>o</sup>The opinions expressed in this paper do not necessarily represent the views of the Farm Economics Research Division, Agricultural Research Service, or USDA.

of the Lorenz curve calls for an array, from smallest to largest, of all individuals according to the amount of the attribute measure of wealth or income with which each is associated. Because both axes are expressed in terms of percentages from 0 to 100, the line of perfect equality is shown as a straight line rising at 45° from the left-hand origin. The more the Lorenz curve bows downward, away from the line of perfect equality, the more unequal is the distribution of the attribute.

The area between the Lorenz curve and the line of perfect equality represents the degree of concentration. This, in fact, is the basis for Gini's R or R', the "concentration ratio." The Gini ratio of concentration, hereafter referred to as C or C' (to avoid confusion with correlation coefficients), is simply the ratio of the area between the Lorenz curve and the line of perfect equality to the total area of the triangle formed by the two axes and the line of perfect equality.

#### Concentration in the Great Plains States

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A study of rural land ownership made in the 10 Great Plains States in 1957-58 provides useful illustrative data for the concentration curve and ratios. In order to provide comparability with a similar survey of farm land ownership made in 1945, only farm and ranch lands of the 1957-58 study of all rural land are used. Concentration curves (Fig. 1) and concentration ratios (Table 1) are developed for both acreage and value.

The concentration curve shows that the distribution of land holdings, measured either in terms of acreage or value, deviates considerably from perfect equality. The concentration curve for acreage encloses two-thirds of the total area beneath the line of perfect equality. One-half of the owners in the 1957-58 study hold 8 per cent of the farm and ranch land;

<sup>&</sup>lt;sup>4</sup> The form originally presented by Lorenz arrayed individuals from largest to smallest in terms of their income. This results in a curve that is concave downward.

<sup>5</sup> The calculation of C (Gini's R) is done by summing the differences of attribute

values for all pairs of observations and dividing by  $\frac{N^3}{4}$ .  $\bar{y}$  (N = total frequency,

 $<sup>\</sup>bar{y}=$  mean of attribute quantities), an extremely laborious process. An estimate of C, that is, C', can be calculated from a succession of points (usually 5 or 10) on the concentration curve or directly from sum of attribute values assignable to successive quintiles or deciles of owners in the array. (See formula, bottom of table 1.)

<sup>&</sup>lt;sup>6</sup> U.S. Department of Agriculture, Agricultural Research Service, Farm Economics Research Division. The data were drawn from a survey of ownership of all rural land taken during December, 1957 and January 1958 in the 10 Plains States from Montana-North Dakota to Texas-New Mexico. Estimates were prepared from the mail questionnaires of approximately 25,000 landowners. All 1957-58 data are preliminary.

<sup>&</sup>lt;sup>7</sup> Buis Inman and William Fippin, "Farm Land Ownership in the United States,"
U. S. Department of Agriculture Misc. Pub. 699, 1949. Data on concentration were
drawn from source materials of this study and are not available in the bulletin.

Table 1. Concentration Ratios: Acreages and Value of Farmland, Great Plains States, 1945-1958

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State	C' acreages		C' valueª	
	1945	1958	1945	1958
North Dakota	.43	.45	.44	.45
South Dakota	.49	.58	.42	.49
Nebraska	.63	.63	.46	.49
Kansas	. 52	.54	.46	. 52
Oklahoma	.62	.61	.59	.60
Texas	.73	.75	.64	.66
Montana	.60	.69	.53	.61
Wyoming	.70	.78	.57	.63
Colorado	.68	.73	.56	.60
New Mexico	.74	.82	.62	.69
Great Plains	.67	.69	.56	.60

 $C' = 1/2\Sigma (P_{k-1} \cdot Q_k - P_k \cdot Q_{k-1}) \cdot \frac{1}{5,000} = \Sigma (P_{k-1}Q_k - P_kQ_{k-1}) \cdot \frac{1}{10,000} ; \text{ where } P_k = \text{per}$ 

cent of owners, and  $Q_k$  = per cent of land acres or value, and k-1 is percentage at interval (decile here) preceding k; C' underestimates C by about 2 per cent.

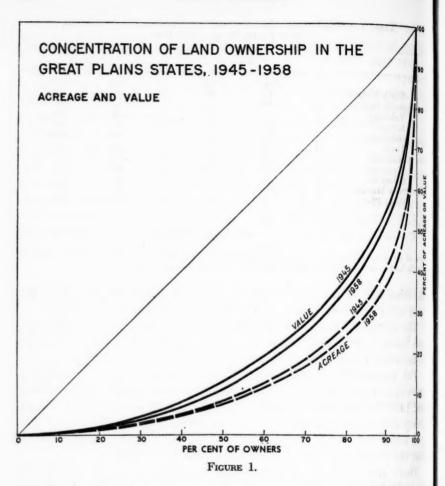
the other half of the owners hold 92 per cent. About 53 per cent of the farm and ranch land is held by the largest 5 per cent of the owners.

The value of farm and ranch land is similarly concentrated, although to a lesser degree. One-half of the owners hold 11 per cent of the value of farm and ranch land; the other half of the owners hold 89 per cent.

The remarkable characteristic of the land ownership concentration curves and ratios for the Great Plains is their near identity between 1945 and 1957-58. The 1945 and 1957-58 curves for both acreage and value are nearly congruent, and the C' ratios are virtually equal. This would suggest either that there has been little or no increase in concentration or that the measuring device is not responsive to differences.

There are, however, wide interstate variations in the C' values. For example, land ownership in North Dakota with an acreage C' value of .45 is little more than one-half as concentrated as New Mexico with a C' value of .82. This wide interstate variation suggests that, as a measure of land ownership concentration, the C' ratios and their graphic counterparts are responsive to differences.

One of the principal advantages of the concentration ratio (and similarly the curve) is that coefficients can be compared directly over time. For the 10 Plains States combined, as an example, the C' ratios for value concentrations in 1945 and 1957-58, respectively, are .56 and .60. During this period the index of land values for these states rose from 80 to 144. Had the number of owners in each class interval of value of holding been compared, it would have been impossible to separate increased concentration (of which there was little) from a general increase in the price of land. The concentration ratio is, of course, totally indifferent to the rise



in average value of an ownership unit from \$15,971 to \$38,431 between 1945 and 1957-58. The sole concern of the concentration ratios is how the total value is distributed among owners of land.

Similarly, the concentration ratio for acreage is unaffected by changes in the total quantity of land or by the number of landowners. The average size of a farm land ownership unit rose from 570 acres in 1945 to 640 acres in 1957-58, an increase of about 1 per cent a year. The C', on the other hand, rose only from .67 to .69, an amount easily accounted for by sampling error.8

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<sup>&</sup>lt;sup>8</sup> For comparison, in 1945, the United States ratio of concentration for income from wages and salaries was .38, income from business and partnerships .68, and income from interest and dividends .82 (Goldsmith, op. cit., p. 327). In 1954, the most recent year for which appropriate data are published, the United States ratio of concentration for income from wages and salaries was .40, income from other than earnings (interest, pensions, etc.) .47, income from farm self-employment .56, income from

# Merits, Limitations, and Variations of the Concentration Curve and Ratio

Conceptually the concentration curve and ratio are specific. The meaning of both is precise in that the base, complete equality, does not rely on a normative judgment and, consequently, does not vary with time or among individuals. The concentration curve is compared, therefore, not with what the distribution of land holdings ought to be, but with the objective standard of perfect equality. The concept of perfect equality as a base from which to measure concentration does not suggest that perfect equality is either attainable or desirable.

One of the principal advantages of the concentration curve over the use of simple class intervals is that direct comparisons can be made between time periods—"between epochs," in the language of Lorenz. From a class interval table<sup>10</sup> it is not possible to tell, for instance, whether between two time periods an increase in the proportion of owners in the largest size class is due to a shift of land from small owners to large owners, or is just the result of a general increase in the size of all landholdings. Both axes of the concentration curve, however, are expressed in percentages, so that a change over time in the value of land or a proportionately equal change in the size of all ownership units will not affect the degree of concentration.

The main limitation of the concentration curve and ratio is their inadequacy to describe all aspects of the distribution of land ownership.
They do not show absolute quantity changes. Neither the curve nor
the ratio makes any distinction between a distribution of ownership
among 10 owners and among 10 million owners. For analyses that require
such a distinction, however, a supplement of the mean acreages, mean
values, or total numbers of land owners usually will be sufficient to show
absolute quantity changes.

A variation of the usual concentration curve might include members of the population possessing zero quantity of the attribute, i.e., to include in a distribution of land owners those who own no land. If one wished

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nonfarm self-employment .54 (U. S. Department of Commerce, Current Population Reports, Income of Persons in the United States; 1954, P-60, No. 19, p. 23). All the foregoing are C' ratios based on the distribution of income among persons receiving such income, and calculated from quintiles which understate concentration slightly more than C' calculated from deciles.

<sup>&</sup>lt;sup>9</sup> For another viewpoint see Allyn Young, Economic Problems New and Old, Boston: Houghton Mifflin Co. 1927, pp. 95-107.

Three relatively recent examples of class interval reporting of acreage distribution of ownership may be found in: (1) Inman, op. cit. p. 68. (2) Woytinsky and Woytinsky. World Population and Production, New York: 20th Century Fund, 1953. Illustrations from Europe, Americas. pp. 489-490. Not always clear between operation and ownership. (3) Manlio Rossi-Doria, "The Italian Agrarian Reform," In Parsons, Penn, and Raup, Land Tenure, Madison, Wisconsin, 1956. p. 391.

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to analyze the distribution of land ownership over a population larger than land owners alone one could simply enter zero observations for all persons owning no land; the resulting concentration curve would follow the ordinate for a considerable distance to the right before it began to rise.

Certain kinds of problems might call for analysis of a population that does not possess the total amount of attribute under consideration. An example might be concentration of ownership of all farmland among farm operators. If all the farmland is not owned by farm operators, then the concentration curve will intercept the y axis below the 100 per cent level.<sup>11</sup>

# Another Use of the Concentration Curve: Owner Characteristics

One shortcoming of many of our current conceptions of a "large" farm or "large" ownership unit is that size comparisons are made on the basis of some absolute size developed from historical data. Size comparisons in one period of time are made according to the technology and resource combinations of a previous period. Farms 1,000 acres or larger, for example, may be classified on the basis of previous experience as "large." Suppose rapid technological advance and consolidation should increase the size of all farms to over 1,000 acres. Are all farms then large? Such a classification is of rather limited usefulness for analysis of the current distribution of farm size, if farm size is undergoing rapid readjustment.

The concentration curve permits a classification of size that can be made without arbitrary standards based on previous periods. The slope of the land ownership concentration curve at any point represents the increment of land owned assignable to an increment of owners. Therefore, it is possible to compare the proportion of all land owned by a particular owner with the proportion of all owners that he represents. A slope of the concentration curve greater than one, for example, is characteristic of an owner who holds a percentage of land greater than the percentage of owners he represents. A slope of the concentration curve less than one means that he contributes more as a proportion of owners than as a proportion of land owned. Owners thus might be classified, for example, as

"Large"-slope of concentration curve (much) greater than one.

"Medium"-slope of concentration curve (about) equal to one.

"Small"-slope of concentration curve (much) less than one.

The number of owner classes desired can be varied, of course, by the number of slopes of the segments of a concentration curve.

<sup>&</sup>lt;sup>11</sup> The desirability either of inclusion of possessors of zero attribute or exclusion of a particular segment of the possessors of the attribute must be weighed against increased difficulty of defining the study universe and preserving comparability in the study universe over time.

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clusion against llity in Another means for classifying characteristics of owners related to the concentration curve is the separation of the arrayed owners into quintiles and deciles. As an example, for the Great Plains states in 1945, the percentage of owners in specified occupational and tenure classes of the largest 10 per cent of land owners was compared with the percentage of owners in the same occupational and tenure classes of all land owners:<sup>12</sup>

Occupation	All owners	Largest 10 per cent
Farmer	65	71
Retired farmer	10	9
Retired other	1	2
Housewife	4	1
Business and professional	11	14
Other	9	3
Tenure		
Owner operator	36	19
Part owner	18	23
Operator landlord	19	35
Landlord	27	23

Thus, the concentration curve, the concentration ratio and the array of land owners from which they are constructed are useful not only as direct measures of concentration but as a means for classifying owner groups.

<sup>&</sup>lt;sup>a</sup> Similar data for the 1957-58 survey are not available at the time of this writing.

# PROBLEMS IN THE IMPLEMENTATION OF THE OBJECTIVES OF GRADUATE TRAINING

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THERE are a number of questions relating to graduate training which are usually left to the administrative personnel of individual institutions as which might properly be discussed by a specialized interest group such as this society. How many of the general problems in graduate training could be simplified through encouraging discussions between schools in subject-matter areas rather than leaving it to be developed primarily within schools? Of foremost importance in the development of policy guiding graduate training is the clarification of its precise objectives. There are three major types of situations to which the Ph.D. may lead. These are teaching, research, and executive positions requiring the generation of decisions for direct action. What are the essential common characteristics and what are the unique specifications for each kind of activity? Economists are also sometimes classified as general, applied or specialist Is this of any assistance? This second classification is quite independent of the first but in both cases the distinctions may not be entirely clear and no life-time work would involve any economist solely in a single category.

If we inspect the components, talents and/or information required for each of the above activities or by any of the types of economists employed in any of various institutions, the problem of defining objectives for graduate training may not be so difficult. If we follow an expanded version of Brinegar's specifications, the components in the training of an agriculture economist are: (1) contemporary economic history with emphasis on agriculture, (2) contemporary social, economic and political institutions and structure, (3) contemporary technology, (4) economic theory, (5) statistics and other quantitative methods, and (6) applied economics in research The first three items collectively are facts, collateral learning and experience while the latter three are tools and their application. The most important element, the research process or the decision process itself, must be included among the above components. This component is most frequently neglected and yet is most important in developing insight into problems, be they research or in the "decision" area. In fact, it is essential to recognize the two as resulting from one and the same process of investigation or logical reasoning. The process is that of learning. The ability to use it differentiates between the educated and the unlearned Questions concerning appropriate content of curriculum are of major

<sup>1</sup> See George K. Brinegar, "Teaching Economics in Colleges and Universities," Journal of Farm Economics, November, 1956. TIVES

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significance and require definition of proportion as well as the components of the above six areas. Widely divergent types of training offered at various institutions is ample evidence that there are wide differences of opinion as to what is ideal. This topic alone is worthy of at least a series of papers.

In addition to content there are several other questions relative to curriculum which arise. These stem from the need for flexibility to accommodate students from diverse backgrounds and training at the one end to a need for both the M.S. and Ph.D. alternatives, as well as different areas of specialization at the other. One of these questions involves the method of exposure of students to subject matter within courses. Should courses be highly organized in presentation or should they be more like "group study" with only consultation with faculty? Should major portions be elected as individual study either with or without frequent faculty contact?

Other questions arise in the organization of the whole curriculum. Should it be highly rigid as to content components and sequence? If specific components are required, then some rigidity of sequence is necessary. A course of study with strict adherence to specified components given in a fairly rigid sequence through the primary medium of lectures might be designated as the "mill" extreme of the American graduate training system. If we release the restriction on components, we would have what might be designated as the "American Smorgasbord." The European system more typically follows the selection of content by individual faculty advisers taken in a more flexible sequence and with much less formal organization. The "mill" tends to produce individuals recognizable as belonging to certain schools. The European system can generate "little images." Neither is particularly desirable. There is probably a very low correlation between the combination used and whether the product is educated or unlearned. The selection of method must be made on other grounds. Important among these are availability and economy in use of faculty and the number and types of students which it is deemed desirable to reach.

If we are to suppose that some means of exposing students to subject matter is available and that some restrictions on content and sequence are necessary, the need for establishing individual programs for students introduces certain additional problems with respect to structuring of curriculum. These are quite apart from interdepartmental problems. As was indicated earlier, there may be differences in objectives of students in the area of specialization in which they wish to concentrate. There are problems in determining how specialized the specialty should be. There may be a need to convince the student that what he may wish to do, including supporting work, is not always what he needs and what he ought to

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have. There are differences between students in the level (i.e., M.S. or Ph.D.) of work desired. Incomplete and diverse preparation at the undergraduate level, perhaps, causes more difficulty in scheduling compact and "neat" programs than any other single item.

These are not the only reasons for the need for some flexibility in training. Not all students are prepared to take an identical series of courses. Many find it essential to work and require something less than "standard full load." Others, because of differences in ability, may prefer to lighten the load. Foreign students, because of background differences and language difficulties, may also wish to start with lighter course loads. If any flexibility in the area of specialization is to be permitted, it is essential that it be possible to select elective courses in either semester. It may also be desirable to have a program which would allow students to enter in mid-year.

A special problem exists with respect to foreign students. The problem of evaluation of previous scholastic record is even more complex than for graduates of American universities. This pertains to level of work as well as to components. Unless previous experience with students from the same university is available, grades and transcripts are of little value. Evaluation of adequacy of direct prerequisite work, as well as general ability, is nearly impossible. If it is in the national interest to have a large proportion of the foreign students who study abroad take work in this country, two questions are foremost. Are all of those students who are capable and apply being admitted? Is the type of training received adequate for conditions they find when they return home? It is not likely, however, that maintaining a separate (and lower) set of standards for foreign students would be helpful since these would tend to draw more mediocre students relative to other foreign universities and depreciate the reputation of American universities abroad.

Another major problem area lies in the control of the supply of graduate students. Students are an asset in that they help to "justify" the department, they provide stimulation to staff members and contribute to the output of the department. Should admission standards be sufficiently flexible to admit all potentially good students or should a rigid line be drawn at some level of undergraduate proficiency if we suppose that it is possible to compare academic records between schools?

Many, if not most, graduate students require some outside financial support. To assist financially most departments have assistantships (research and/or teaching) available for qualified candidates. There are several conflicting criteria which may be used in allocating assistantship funds. (1) They may be considered as scholarship funds and allocated purely on the basis of scholarship. If this is true, they are rewards for previous work. On the other hand some weight may be given to need, in

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which case the award serves two other related functions: namely (a) equity in opportunity to the individual and (b) a contribution to the social product. (2) Assistantships may be awarded on the basis of potential contribution to the research or teaching product. In this instance, need would have no weight, and scholarship considered only to the extent that it might indicate suitability for the job at hand. Major emphasis would have to be given background (academic and experience) with respect to the work to be done. (3) Even though assistantship experience may contribute materially to the training of a student, no weight can be given in this respect since it could be made part of the formal requirements (without pay) in addition to the thesis. (4) Assistantship funds could be allocated as a form of social welfare (i.e., relatively high weight given to need). (5) Perhaps the most frequent criteria for allocating assistantship funds is on the basis of maximizing the probability of acquisition of the better brains for the particular school. To what extent has competitive bidding been responsible for raising stipends above that necessary for students? How many worthy students are shut out of financial assistance because of this high priority given larger stipends?

Who should be responsible for the detail of the graduate curriculum and its administration? If students are not solicited by individual faculty members and assistantships allocated accordingly, there arises the question of student assignment to faculty members. Associated with this is the appropriate advising procedure to assure that students' interests are fully aroused, that students are fully informed as to all possible alternatives and are not unduly burdened by the projection of biases of individual faculty members. Is there any appropriate examination and review procedure which will forewarn weak students that they are "not likely to make it" before they have invested two or more years of work that has little reward in any sense? To what extent should theses be subsidized through assistantships? What facilities are available for special students who may wish to take selected graduate work without a degree? What facilities are available for post-doctoral study? What facilities are available for special foreign students? In each of the last three cases, it is highly likely that programs could be arranged which would be much more effective than those available with present facilities.

In 1953 Black reported an undergraduate curriculum in agricultural economics in 39 land grant schools.<sup>2</sup> Between 1953 and 1957, inclusive, 361 Ph.D. degrees in agricultural economics have been granted by 22 land grant institutions.<sup>3</sup> Of these, 328, however, have been granted by

<sup>&</sup>lt;sup>2</sup> John D. Black, Economics in Agricultural College Curricula, *Journal of Farm Economics*, November. 1953.

<sup>&</sup>lt;sup>3</sup> As reported in lists of Ph.D. dissertations, *Journal of Farm Economics*, 1953-57, inclusive. An additional 31 have been granted by five private institutions.

the 11 larger institutions and over half of the total by the four largest. Most other land grant institutions having agricultural economics at the undergraduate level provide graduate training at the M.S. level. How much coordination exists between institutions to provide an easy transition from one level and school to the other without undue loss of time and credit by students? Can undergraduate and M.S. programs be developed to minimize inadequacy in prerequisite work in transfer to other graduate schools without conflicting unduly with undergraduate objectives and flexibility for various types of work? Many of the deficiencies could be eliminated at the undergraduate level by appropriate student advising. How much of the "feed-in" problem could be solved by some inter-institution coordination of undergraduate and M.S. advising on the selection of curriculum components?

While we recognize that the prime requisite for progress of the profession is an unrestricted method and scope of inquiry by individuals and institutions, does this also necessarily mean that graduate training must be entirely disorganized? While more coordination may be beneficial to agricultural economics directly, it is evident that most of the cost of disorganization is borne by students. Considering the severe limitation on total time which students have available for graduate study, might there also be a considerable indirect benefit from coordination which would release time for more productive study? How many of the above problems could be simplified if more deliberate attention and open discussion were

to be encouraged within this society?

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Chairman: A. Gordon Ball, Iowa State College

# TECHNOLOGY REDEFINED—AN EXAMPLE OF QUANTITATIVE MEASUREMENT IN THE BROILER INDUSTRY

AKIRA UCHIDA

Purdue University

The broiler industry is one of the most dynamic in the United States. In the broiler processing plants, capacities have been increased by more capital expenditure. In any industry where new technologies are rapidly accepted, it is of paramount importance to compare internal plant structures in order to study profit potentials. Traditionally, the comparison has been by constructing and comparing short-run average cost curves for different sizes of plant operation. Assuming a purely competitive market, a comparison of average cost curves would indicate relative profitability of scales of operation for the firm.

The fixed structure of plant size, which in the short run cannot be changed, has a substantial influence upon operational efficiency. Thus, it is possible to evaluate the superiority of one plant relative to another where the investment pattern for equipment and buildings is limiting and where the pattern also technically determines labor which is a part of variable cost.

It is possible to build a long-run technology trend curve which is analogous to Marshall's long-run average cost curve if a basic technology is measured as analogous to the tangency point between the short and long-run average cost curves. Mrs. Joan Robinson has defined technology under a certain state of knowledge by parameters of labor, capital and equipment, and output.<sup>1</sup>

The purpose of this paper is to redefine technology as a vector and to construct a technology trend curve by connecting superior plant technologies. This will suggest the entrepreneurial path necessary in finding a higher profit potential for a competitive industry.<sup>2</sup>

<sup>\*</sup>Approved for publication as Purdue Journal Paper No. 1324, August 8, 1958. This paper is based on research project XR 1457 financed by Purdue Research Foundation. The author would like to acknowledge assistance from Milton M. Snodgrass and Vernon W. Ruttan of the Purdue Agriculture Economics staff.

Joan Robinson, The Accumulation of Capital, Homewood: Richard D. Irwin, Inc., 1956, pp. 411-420.

<sup>&</sup>lt;sup>2</sup> Shoichi Mizuno, "On the Theory of Production Function of Joan Robinson," *The Hitotsubashi Economic Review*, Vol. 8, No. 2, April 1957, pp. 172-173, and Hiroshi Furuya and Ken-ichi Inada, "Balanced Growth and Dynamic Efficiency in Capital Accumulation," *The Economic Studies Quarterly*, Vol. 8, No. 1, 2, June, 1957, pp. 67-69.

#### Theoretical Model

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### Notation of Vector

E = combination of capital and equipment

KE = quantity of capital and equipment3

L=amount of labor input

X = output

T = convex cone of vector field denoting technology

If any two arbitrarily chosen technologies belonging to T cannot be expressed as a combination of the two, then there is a unique technology called a basic technology. The aggregation of such basic technology is noted as T\*; i.e., the number of basic technologies is finite, or T\* is a finite aggregation of many technologies. The elements of T\* are designed as t\*.

# Definition of Technology

When X is produced by combining E and L, the combination

$$\tau = \begin{bmatrix} \mathbf{E} \\ \mathbf{L} \\ \mathbf{X} \end{bmatrix} \equiv \begin{bmatrix} \mathbf{K}_{\mathbf{E}} \\ \mathbf{L} \\ \mathbf{X} \end{bmatrix}$$

is called technology.

# Assumptions

- 1) Homogeneous labor.
- 2) Every element of capital goods increases proportionately as total investment increases.
- 3) Output is forthcoming from any one of many technologies arbitrarily chosen. Technology is a state of expression of production consisting of a certain combination of capital equipment and a flow of labor: a part of labor is for the maintenance of capital equipment.

<sup>&</sup>lt;sup>3</sup> Joan, Robinson, op. cit., pp. 117-123. In the consumer goods sector of economy, the quantity of new capital and equipment is determined by variable factors of interest rate, wages, the pattern of labor input practices, expected life of equipment, etc. In the capital goods sector of economy, variables such as gestation period and labor required to produce the equipment are also considered. In general, the quantity of equipment is expressed as  $K_E = K(E, r, w)$ , where r is interest rate and w is wage rate. It is extremely difficult to see the functional relationship between  $K_E$  and r and w. However, it could be assumed:

<sup>1)</sup> under a certain E and w:

if  $r_1 \ge r_2$ , then  $K(E, r_1, w) \ge K(E, r_2, w)$ 2) under a certain E and r:

if  $w_1 \ge w_2$ , then  $K(E, r, w_1) \ge K(E, r, w_2)$ 3) for  $E_1$  and  $E_2$  and two combinations: (r, w) and (r', w'):

if K(E<sub>1</sub>r, w)>K(E<sub>2</sub>, r, w), then K(E<sub>1</sub>, r', w')>K(E<sub>2</sub>, r', w')

Champernowne calls K<sub>E</sub>\L (capital equipment investment per worker) a "J. R. Unit."

See also D. G. Champernowne and R. F. Kahn "The Value of Invested Capital," Review of Economic Studies, Vol. 21, No. 2, 1953.

- 4) No persistent excess capacity in capital and equipment.
- 5) State of equilibrium maintained as entrepreneur believes that the existing wage rate and interest rate will remain the same in the future.
- 6) Divisibility of capital and equipment and labor within each plant and the constancy of revenue; i.e., if capital equipment is λ-fold (λ>0), output is λ-fold. Also additivity of technology; i.e., the output of the sum of combinations of more than two different capital and equipment labor inputs is the sum of the output of each combination of capital and equipment and labor inputs.
- 7) Aggregation of all technology under a certain state of knowledge is expressed by T. Under a different state of knowledge T' exists:

$$T \neq T'$$

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Under the foregoing assumptions, the nature of T is as follows:

1) If  $\tau$  belong to T,  $\lambda \tau$  also belongs to T ( $\lambda > 0$ ). If

$$au = \left[ egin{array}{c} \mathbf{E} \\ \mathbf{L} \\ \mathbf{X} \end{array} 
ight], \quad ext{then} \quad \lambda au = \left[ egin{array}{c} \lambda \mathbf{E} \\ \lambda L \\ \lambda \mathbf{X} \end{array} 
ight]$$

2) If both  $\tau_1$  and  $\tau_2$  belong to T, then  $\tau_1 + \tau_2$  belong to T. then

$$au_1 = \begin{bmatrix} \mathrm{E}_1 \\ \mathrm{L}_1 \\ \mathrm{X}_1 \end{bmatrix}, \qquad au_2 = \begin{bmatrix} \mathrm{E}_2 \\ \mathrm{L}_2 \\ \mathrm{X}_2 \end{bmatrix}, \quad ext{and} \quad au_1 + au_2 = \begin{bmatrix} \mathrm{E}_1 + \mathrm{E}_2 \\ \mathrm{L}_1 + \mathrm{L}_2 \\ \mathrm{X}_1 + \mathrm{X}_2 \end{bmatrix}$$

3) Combining (1) and (2): if both  $\tau_1$  and  $\tau_2$  belong to T,

$$\binom{\lambda_1 > 0}{\lambda_2 > 0}$$

then  $\lambda_1 \tau_1 + \lambda_2 \tau_2$  also belong to T. Therefore:

$$\lambda_1 \tau_1 + \lambda_2 \tau_2 = \begin{bmatrix} \lambda_1 E_1 + \lambda_2 E_2 \\ \lambda_1 L_1 + \lambda_2 L_2 \\ \lambda_1 X_1 + \lambda_2 X_2 \end{bmatrix}$$

4) Combination of the two technologies belonging to T is expressed by combination in  $\lambda$  ratio, if

$$t = \lambda t_1 + (1 - \lambda)t_2, \quad (0 \le \lambda \le 1)$$

 Within the same T, the combination in which L=1 is called unit Technology.

$$\frac{\tau}{\mathbf{L}} = \begin{bmatrix} \mathbf{K_E} \\ \mathbf{1} \\ \frac{\mathbf{X}}{\mathbf{L}} \end{bmatrix}, \text{ expressed as } t = \begin{bmatrix} \mathbf{K_e} \\ \mathbf{1} \\ \mathbf{x} \end{bmatrix}; \text{ unit technology of } \tau.$$

 $K_e$  and x are capital equipment and output per unit of labor, respectively.

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# Comparison of Technology

If there are two technologies,

$$t_1 = \begin{bmatrix} K_{e1} \\ 1 \\ x_1 \end{bmatrix} \quad \text{and} \quad t_2 = \begin{bmatrix} K_{e2} \\ 1 \\ x_2 \end{bmatrix}$$

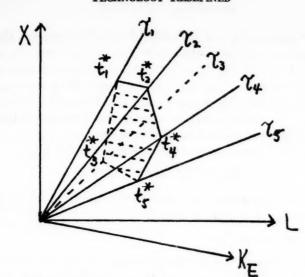
belonging to T and if  $x_1>x_2$ , and  $K_{e1}< K_{e2}$ , then  $t_1$  is less mechanized and superior; higher mechanization does not always mean the superiority of one technology over another. Therefore, if the combination of capital and equipment is defined as above, under a constant interest rate and wage rate, each technology is expressed in such vectors as:

$$\tau = \begin{bmatrix} \mathbf{K} & (\mathbf{E} \mid \mathbf{r}, \mathbf{w}) \\ \mathbf{L} \\ \mathbf{X} \end{bmatrix} \qquad \frac{\tau}{\mathbf{L}} = \begin{bmatrix} \frac{\mathbf{K}(\mathbf{E} \mid \mathbf{r}, \mathbf{w})}{\mathbf{L}} \\ 1 \\ \frac{\mathbf{X}}{\mathbf{L}} \end{bmatrix}$$

expressed as:

$$\mathbf{t} = \begin{bmatrix} \mathbf{K} & (\mathbf{e} \mid \mathbf{r}, \mathbf{w}) \\ 1 \\ \mathbf{x} \end{bmatrix}$$

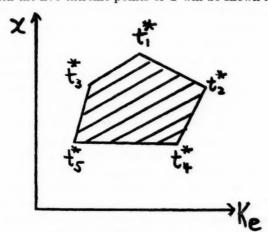
For example, there are five basic technologies,  $t_1^*$ ,  $t_2^*$ ,  $t_3^*$ ,  $t_4^*$ ,  $t_5^*$ . With these, T will be shown by the convex cone as below:



If T is cut with a plant at L=1 perpendicular to the L axis and parallel to the  $XK_E$  plane, then the shadowed area is T at L=1. If this bisected shaded area is transformed into a two dimensional graph,

$$\left(\frac{X}{L}, \frac{K_E}{L}\right)$$

or (x, Ke), then the five extreme points of T will be shown as follows:



It is clear from the above diagram that purely from the standpoint of capital and equipment intensity relative to labor,  $t_2^*$  is the most mechanized followed by  $t_4^*$ ,  $t_1^*$ ,  $t_3^*$ , and  $t_5^*$ , respectively.

If two technologies,  $t_i^*$  and  $t_i^*$ , are such that  $K_{ei} > K_{ei}$  and  $x_i < x_i$ , then  $t_i^*$  will dominate  $t_i^{*,4}$  Within T, those technologies which are not dominated

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 $<sup>^4</sup>$  A weaker expression of the inequality sign could be used; for example, in the above figure

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by the other technologies are designated by  $\widehat{\mathbf{T}}^*$ . Furthermore, those technologies which are not dominated under a certain interest rate and wage rate will not be dominated by others under a different interest rate and wage rate. Therefore, we find in the above figure,  $\widehat{\mathbf{T}}^*$  as connected by the line of  $t_1^*$ ,  $t_3^*$  and  $t_5^*$ . The characteristics of this so-called optimum technology curve will depend upon the industry characteristics in terms of investment in capital equipment relative to the labor.

Regarding the following case of technology comparison, i.e.,

$$K_{ej} > K_{ei}$$
 and  $x_j > X_i$ ,

we cannot say anything about the superiority of one technology to the other. This is purely an indeterminate case.

### Technology and Profitability<sup>5</sup>

The profit is determined by the difference between revenue and cost. Nothing can be said definitely about the profitability of one operation to the other. However, under the suitable assumptions listed earlier in the theoretical model section of this paper, the above technology expressed in such vector components would give us a fairly good estimate of the profit ability, i.e., those technologies which are not dominated are more profitable than those which are. A case can exist where one technology is dominated by another and yet a profit can occur for the inferior technology. Also, in indeterminate cases, if the operation with the higher capital investment and output has substantially less average variable costs (excluding labor), then it probably has higher profit potential; e.g., where  $K_{ei} > K_{ej}$  and  $x_i > x_j$ , then i probably has higher profit potential.

Without the assumptions, it cannot be determined the share that labor contributes to total profit for any particular technology because if the value of capital is less, the rate of profit on capital may be higher. This makes the elasticity of substitution between labor and capital a crucial factor. If elasticity is greater than unity, overinvestment will imply a larger profit share of capital investment than labor. If less than unity, a labor intensive operation would be more profitable. When there is a difference between a capital or a labor intensive operation under different technologies, it is almost imperative to consider the elasticity of substitution of labor and capital within the technology before saying anything about the exploitation of labor or management. Considering the competitive structures of the labor market, it is safe to say that the higher actual wage rate in a particular

in the comparison of  $t_5^*$  is superior to  $t_4^*$ ; if  $x_5 \ge x_4$  and  $K_{c5} < K_{c4}$ , then  $t_5^*$  is superior to  $t_5^*$ . A weaker inequality sign could be used on capital instead of output; however, the weak inequality sign cannot be used on both capital and output comparisons.

<sup>&</sup>lt;sup>5</sup> The meaning of the profitibility is in terms of the absolute sense, as well as proportion or share of capital relative to labor.

technology is the proximate cause of the higher productivity, because it is higher wages that make a more rather than a less mechanized technique preferable from the entrepreneur's standpoint. It might be possible to have higher wages without higher productivity, but it would not be possible under competitive conditions to have higher productivity without a higher wage. Therefore, under the assumption of pure competition, the dominance of one technology over another could have profitability implications.

### Example Using Empirical Data

Empirical data used are taken from a recent study of broiler processing in North Carolina. Actual plant data were divided into four groups by size of operation. Pertinent data are:

Groups	Average output per hour	Average investment in buildings and equipment	Labor
	dressed lbs.	dollars	persons employed
1	375	18,421	18
2	900	35,047	25
3	1800	60,557	44
4	3200	169,542	103

Using these data, the technology matrix is:

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$$\tau_{1} = \begin{bmatrix} 18,421 \\ 13 \\ 375 \end{bmatrix} \Rightarrow \frac{1}{13} \begin{bmatrix} 18,421 \\ 13 \\ 375 \end{bmatrix} = \begin{bmatrix} 1417 \\ 1 \\ 29 \end{bmatrix} \\
\tau_{2} = \begin{bmatrix} 35,047 \\ 25 \\ 900 \end{bmatrix} \Rightarrow \frac{1}{25} \begin{bmatrix} 35,047 \\ 25 \\ 900 \end{bmatrix} = \begin{bmatrix} 1402 \\ 1 \\ 36 \end{bmatrix} \\
\tau_{3} = \begin{bmatrix} 60,557 \\ 44 \\ 1800 \end{bmatrix} \Rightarrow \frac{1}{44} \begin{bmatrix} 60,557 \\ 44 \\ 1800 \end{bmatrix} = \begin{bmatrix} 1376 \\ 1 \\ 41 \end{bmatrix} \\
\tau_{4} = \begin{bmatrix} 169,542 \\ 103 \\ 3200 \end{bmatrix} \Rightarrow \frac{1}{103} \begin{bmatrix} 169,542 \\ 103 \\ 3200 \end{bmatrix} = \begin{bmatrix} 1646 \\ 1 \\ 31 \end{bmatrix}$$

<sup>&</sup>lt;sup>8</sup> James R. Donald and Charles E. Bishop, "Broiler Processing Costs," A. E. Information Series 59, Department of Agricultural Economics, North Carolina State College, June, 1957

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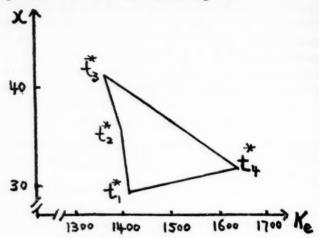
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A graphic picture of the above unit technologies is:



Comparison of Basic Technology

The degree of mechanization is t<sub>4</sub>\*, t<sub>1</sub>\*, t<sub>2</sub>\*, and t<sub>3</sub>\* in order. The comparisons of the basic technologies are as follows:

$$t_1^* \text{ vs. } t_2^* \quad K_{e1} > K_{e2} \quad x_2 > x_1 \quad \therefore \tau_2 \supseteq 1$$

using the notation  $i \ni j$  meaning i is superior to j.

Therefore:

$$au_3 \supseteq au_2$$
 $au_2 \supseteq au_1$ 
 $au_3 \supseteq au_1$ 
 $au_3 \supseteq au_4$ 
 $au_2 \supseteq au_4$ 
 $au_3 \supseteq au_4$ 
 $au_3 \supseteq au_2 \supseteq au_4$ 

### Summary

There was no so-called optimum technology curve T\* constructed as indicated by the theoretical model. However, the entrepreneurs of technology

<sup>&</sup>lt;sup>7</sup> This optimum technology curve is Mrs. Joan Robinson's productivity curve, which is depicted always by constructing the multi-convex cone instead of a single convex cone for technology for an industry if the industry is operating within the range of economy of scale.

nologies 1 and 4 are induced to attain technologies 2 and finally 3. This suggests that the broiler industry is a very dynamic industry. This entrepreneurial path for better technology is analogous to Marshall's long-run average total cost curve, though the long-run path is exactly in the opposite direction: in the technology trend curve a higher profitability is implied by going from lower right to upper left, while in the long-run average cost curve, economy of scale is obtained by going from upper left to lower right.

# DISCUSSION: TECHNOLOGY REDEFINED—AN EXAMPLE OF QUANTITATIVE MEASUREMENT IN THE BROILER INDUSTRY

IRVING DUBOV
University of Tennessee

Uchida's paper is an interesting exercise in applying matrix algebra to problems in agricultural economics. It is most gratifying that those training in our profession are alert to the application of fresh approaches.

The stated purpose of the paper is "to redefine technology as a vector and to construct a technology trend curve by connecting superior plant technologies." It is stated further, "This will suggest the entrepreneurial path necessary in finding a higher profit potential for a competitive industry." The question now is whether the purpose was reached, and, if so, what contribution this is.

Mathematics is a science of logic—reasoning from a given set of assumptions. Uchida follows this procedure, and reasons from a simplified set of assumptions. Except for a minor point or two,¹ there is no fault with the logic. Some questions may be raised, however, regarding the simplicity of the assumptions. For example, does the broiler industry operate in purely competitive factor and product markets? Some serious doubts can be raised in this connection. The strongest basis for these doubts is the growth of vertical integration in the industry selected for an example of research application. Also, there are many substantial departures from purely competitive factor and product markets in many other phases of agricultural production and processing. Under such circumstances, then, will the research procedure outlined be of use?

 $K_{ej} > K_{ei}$  and  $x_j > x_1$ 

we cannot say anything about the superiority of one technology to the other. This is a purely indeterminate case." The case is indeterminate only so long as costs and returns are ignored.

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<sup>&</sup>lt;sup>1</sup> The following is stated in the paper:

<sup>&</sup>quot;Regarding the following case of technology comparison, i.e.,

Another point concerns the example given of research application—that of the North Carolina broiler industry. Is an elaborate use of vectors required to determine which production organization is associated with maximum output per unit of labor?

In discussing technology and profitability, the following is said: "The profit is determined by the difference between revenue and cost. Nothing can be said definitely about the profitability of one operation to the other. However, under the suitable assumptions listed earlier in the theoretical models section of this paper, the above technology expressed in such vector components would give us a fairly good estimate of the profitability, i.e., those technologies which are not dominated are more profitable than those which are." Profitability is determined by more than the value of capital and equipment and output per man hour of labor. Profitability is determined by manipulation of and adjustment to all the variables of market policy. These variables include product policy, expenditures for selling costs, market power, location with regard to markets, transportation costs, and contractual arrangements.

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Perhaps, the foregoing remarks are conditioned by some recent experience with a study of pricing of Class III milk in the New York milkshed. One of the most important questions with which the study was concerned was: "How will a change in the Class III price affect the firms operating in the area?" The impression gained in pursuing this question was that the variables of market policy mentioned above are the strategic ones considered by decision-makers in the dairy firms. A simple model, such as that presented in Uchida's paper, would be of little significance to the firms in the dairy industry. And, since the broiler industry is becoming more and more "imperfectly competitive," the same limitations mentioned for the dairy industry might also exist for broiler production.

Recent developments in the methodology of agricultural economics research—particularly those of applying linear programming—have provided many useful tools of analysis. Care must be taken, however, that the tools are used properly to test reasonable hypotheses of economic activity. These hypotheses must be based on realistic premises. Otherwise, the application of the refined analytical tools will become mere academic exercises.

In summary, Uchida has done a competent job as far as he has gone. There needs to be, however, many refinements and advancements of the procedure before it can begin to answer really substantive questions. The model needs to take into consideration the many other important variables of firm behavior that it now omits.

# AN INPUT-OUTPUT ANALYSIS OF A SMALL HOMOGENEOUS AGRICULTURAL AREA\*

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North Carolina State College

A PRIMARY goal of studies of an agricultural area is frequently the development of economic policy leading to efficient use of resources in agricultural production. A study of this nature might be made on any one of three different levels: (1) intra-farm, (2) inter-farm, and (3) interindustry. Analysis on the first level deals with the individual farm and can be considered analysis of the "firm." Analysis on the last two levels is of an aggregative type where the focus is shifted from the individual firm to larger units.

A good guide for adjusting resource use for better efficiency and for making policy recommendations concerning agricultural production of the area is a comprehensive economic model that will give expression to production-consumption relations, inter-industry relationships, and production functions—all on the aggregate level. This model should also show how economic conditions influence the economic activities and resource allocation in the area.

Appropriate for such a study is the input-output model which permits us to use the method of activity analysis on the aggregate level. Since this model was introduced in 1931 by Wassily W. Leontief of Harvard University, it has been used in numerous economic studies, but in each the analysis has been applied to a large economic area such as a whole country or a state, and has covered all sectors and activities of the economy. In order to fit into a study of agricultural activities of a small area, some modifications and additional assumptions are necessary.

The purpose of this paper is to describe how the input-output model can be applied in a regional study of a small homogeneous agricultural area and to illustrate important applications of the analysis to such a study. The analysis discussed here has been applied in a study of eight counties of the Northern Tidewater area in North Carolina, and numerical examples will be drawn from that study.

# Input-Output Analysis

An input-output analysis consists of four parts: (a) choice of a specific model; (b) the collection of data summarized in a table which describes the

<sup>\*</sup>Approved by the Director of Research of the North Carolina Agricultural Experiment Station as Paper No. 948 of the Journal Series, Raleigh, North Carolina (August 1958).

<sup>\*\*</sup> The writer is indebted to Richard A. King for encouragement and assistance in this paper and in the research upon which the paper is based.

<sup>&</sup>lt;sup>1</sup> The research study under the title, "The Agricultural Economy of the Northern Tidewater Area of North Carolina" is still in progress.

economic system; (c) estimation of coefficients using appropriate analytical techniques; and (d) numerical solutions of the problems posed.<sup>2</sup>

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The model represents economic activities of a certain geographical area, during a certain period of time (usually one year). Assuming free competition, constant returns to scale and static equilibrium conditions, and dividing the economy into number of sectors, an input-output table of the following type can be constructed:

TABLE 1. GENERAL INPUT-OUTPUT MODEL FOR n SECTORS

Day descine and an	Inter	mediate flows	Final demand	70.11
Producing sectors -	1	2 · · · j · j · · · n · n	Final demand	Total output
1	X <sub>11</sub>	x <sub>12</sub> · · · x <sub>1n</sub> · · · x <sub>1n</sub>	Y <sub>1</sub>	X <sub>1</sub>
2	X21	$x_{22} \cdot \cdot \cdot x_{2n} \cdot \cdot \cdot x_{2n}$	$\mathbf{\overset{Y_1}{Y_2}}$	$egin{array}{c} \mathbf{X_1} \\ \mathbf{X_2} \end{array}$
i	$x_{ii}$	$x_{i2} \cdot \cdot \cdot x_{ij} \cdot \cdot \cdot x_{in}$	$Y_i$	$\dot{\mathbf{X}}_{\mathbf{i}}$
				:
n	$x_{n1}$	$x_{n2} \cdot \cdot \cdot x_{nn} \cdot \cdot \cdot x_{nn}$	$Y_n$	$\dot{\mathbf{X}}_{\mathrm{n}}$

In this table,  $X_i$  represents the total physical output of the ith sector (for  $i=1,2,\cdots,n$ );  $x_{ij}$  represents the amount of output of sector i that is absorbed by sector j to be used as an input; and  $Y_i$  represents the amount of  $X_i$  that is consumed by households, purchased by government or exported. Each row in the Table thus shows the distribution of output of a sector, and each column shows the inputs of a sector and their sources. When intrasector flow has been cancelled out, each element of the diagonal  $x_{ij}$  for i=j is zero and the output is defined on a net basis. But if  $x_{ij}>0$  (for i=j), output in sector i is stated on a gross basis.

Assume that each sector uses only one process and produces a single commodity with no joint products, that there are no substitutions of inputs, and that there are constant returns to scale. Each column then represents a sector's process which is a linear homogeneous production function.

<sup>&</sup>lt;sup>2</sup> For lack of space, only the basic and the main points of the analysis are shown here briefly for the purpose of establishing a general notation in terms of matrices and equations to be used later. For a basic reference see, W. W. Leontief, *The Structure of the American Economy*, 1919-1939, Oxford University Press, 1951.

For reasons of aggregation and lack of physical data all these entries are quoted in money values.

<sup>&</sup>lt;sup>4</sup> Samuelson argues that this assumption is not always necessary. See P. A. Samuelson; "Abstract of a Theorem Concerning Substitutability in Open Leontief Models," in T. C. Koopmans (ed.), Activity Analysis of Production and Allocation, 1951, pp. 142-46. And also: R. Dorfman, A. P. Samuelson and R. M. Solow, Linear Programming and Economic Analysis, New York: McGraw-Hill Book Co., 1958, pp. 204 and 224-227.

The following set of linear equations can be derived from Table 1:

$$X_{1} - x_{11} - x_{12} - \cdots - x_{1n} = Y_{1}$$

$$-x_{21} + X_{2} - x_{22} - \cdots - x_{2n} = Y_{2}$$

$$\vdots$$

$$\vdots$$

$$-x_{n1} - x_{n2} - \cdots + X_{n} - x_{nn} = Y_{n}$$

$$(1)$$

or in shorter form:

$$X_i - \sum_{j=1}^{n} x_{ij} = Y_i$$
 (i = 1, 2, · · · , n) (1a)

This set of equations can be regarded as describing the external relationships in the general equilibrium, showing the balance of output and inputs.

Further consideration of Table 1 is appropriate with regard to the internal structure, or intersector relationships. The following set of technical coefficients of production (assumed to be constant) is obtained:

$$a_{ij} = \frac{x_{ij}}{X_i}$$
, or  $x_{ij} = a_{ij}X_j$  (2)

The ratio  $a_{ij}$  shows the amount of commodity i which is necessary to produce one unit of commodity j.<sup>5</sup> The set of equations (1a) therefore can be rewritten as:

$$X_i - \sum_{i=1}^{n} a_{ij} X_j = Y_i$$
 (i = 1, 2, · · · , n)

or in matrix form:

$$([I] - [a_{ij}])[X] = [Y]$$
 (4)

where  $([I]-[a_{ij}])$  is the technology matrix of production. [X] is the total output column vector, and [Y] is the final demand column vector.

Multiplication of both sides of (4) by  $([I]-[a_{ij}])^{-1}$  which is the inverse of the technology matrix leads to a new set of equations:

$$A_{11}Y_{1} + A_{12}Y_{2} + \cdots + A_{1n}Y_{n} = X_{1}$$

$$A_{21}Y_{1} + A_{22}Y_{2} + \cdots + A_{2n}Y_{n} = X_{2}$$

$$\vdots$$

$$\vdots$$

$$A_{n1}Y_{1} + A_{n2}Y_{2} + \cdots + A_{nn}Y_{n} = X_{n}$$
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In terms of dollar input per dollar output.

or in shorter form:

$$\sum_{i=1}^{n} A_{ij} Y_{i} = X_{i} \qquad (i = 1, 2, \dots, n)$$
 (5a)

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where the  $A_{ij}$  represents the elements of the inverse of the technology matrix. This set of equations shows the total output of each sector that is required to meet a given final demand.

### Model for a Small Agricultural Area

In constructing an input-output model for a small agricultural area, several factors should be kept in mind:

(a) The study aims to cover only the agricultural activities of the area, although these activities can not be isolated wholly because of economic ties with some nonagricultural sectors.

(b) Even though the geographic area is clearly defined, there are flows of outputs outside the area and flows of inputs into the area. Data generally available for such a study do not reveal, in most cases, output destinations and input origins.<sup>6</sup>

(c) Land is an important primary input and should be considered separately.

Because of these peculiarities, the model as discussed in the previous section needs some modification and additional assumptions in order to fit the present study. Consider n number of sectors, of which n-1 are agricultural sectors covering all the agricultural activities in the defined area. The division into sectors is based on the nature of the product produced, the production technique, marketing organization and ways of consumption. A five-sector model is illustrated in Table 2. The agricultural economy is divided into four broad sectors as follows:

- 1. Crops for direct consumption: Fruits, berries, vegetables and potatoes.
- 2. Feed and forage crops: Grains, pasture, hay and silage.
- 3. Crops for industry: Cotton, tobacco, peanuts and forest products.
- 4. Livestock: Poultry, sheep, beef and dairy cattle, hogs and work stock.

Larger models can be constructed, in which each sector is further subdivided in order to emphasize a particular enterprise that is of special importance in the area studied.

The nth sector—"Industry Services and Outside Activities"—has a special disposal function (Sector 5 in this example). First, it absorbs from

<sup>&</sup>lt;sup>6</sup> Volume I of the U. S. Census of Agriculture, or various state publications are sources that might be used for constructing the model. For problems of finding and using that kind of data, see E. C. Wilcox, "Local Data Requirements in Areas of High Agricultural Specialization," Journal of Farm Economics, December, 1956, pp. 1455-1470.

<sup>&</sup>lt;sup>7</sup> In addition to the five sector general model described here, an 18 sector model (of which 17 are agricultural sectors) has been constructed for the Northern Tidewater Area.

the agricultural sectors all outputs that neither flow as inputs to other agricultural sectors, nor to final demand. This includes surpluses of agricultural inputs flowing outside the area after satisfying the demand within the area. Second, it supplies to the agricultural sectors all the necessary inputs from the nonagricultural sectors, and those from agricultural sectors originating outside and flowing into the area.

Nonagricultural activities within the area that do not have economic relations with any of the agricultural sectors are irrelevant in this model and are not considered here. Also, intersector transfer costs have not been specifically included.

Two additional rows have been included in the model described in Table 2 to represent primary inputs: (1) The  $x_{n+1}$  row gives an estimate of the labor force required in each sector. These estimates are based on the norms acceptable for the various enterprises in the area. Work done off the farm is also shown in this row. (2) The  $x_{n+2}$  row shows the amount of land used in the area. These two rows can be expressed readily in physical units even though the remainder of the table is in monetary units.

The "Final Demand" consists here of two columns: (1) "Government" includes all government purchases at support prices, and direct government payments such as "conservation payments" and others. (2) "Direct Household Consumption" includes all farm products consumed on the farm or sold for off-farm consumption. These are the main parts of the Table.

There is a location problem here which is important, and which helps in understanding some of the activity relations. Items may be located within the area, outside the area, or location may be unspecified. The  $n-1 \times n-1$  part of the table is located within the area. Location of the nth column is unspecified except for those agricultural inputs that are surplus in the area and flow out, and for unused land. Origin of items in the nth row unspecified, except for those agricultural inputs that are deficient in the area and flow into it from outside. In the column "Direct Household Consumption," location is unspecified for those commodities sold in the market.

# An Application of the Model

There are many possible applications which may be of special interest. Some of these applications are discussed below.

# Descriptive Analysis

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The model is the starting point for any analysis, but the model itself provides a fair description of the agricultural activities of the area showing sector interdependencies and relations, the relative importance of sectors

<sup>&</sup>lt;sup>8</sup> For the model of the Northern Tidewater area, the source of data for labor estimations was Walter H. Pierce, and Charles R. Pugh, Cost of Producing Farm Products in N. C., A. E. Information Series No. 52, North Carolina State College, December, 1956.

### PERETZ RAM

Table 2. Five-Sector Model for Input-Output Analysis in a Small, Homogeneous Agricultural Area $^{\rm A}$ 

			Intermedi	ate flows		Intermedi
Produc	cing sectors	Crops for direct consumption (1)	Feed and forage crops (2)	Crops for industry (3)	Livestock (4)	Industry, a outside
Di	ops for irect onsumption	Seeds; plants, trees & vines	X <sub>12</sub> 0	X <sub>13</sub> O	Irish & sweet polatoes fed to livestock	2
Fo	ed and orage rops	X <sub>21</sub> Green manure	X <sub>22</sub> Green manure; seeds	X <sub>23</sub> Green manure	Pasture; grains; hay; silage; green fodder; protein	Grain, so
(3) Cr for Inc		X <sub>21</sub> 0	Fence post	seeds X <sub>33</sub>	Peanut hay; cotton-seeds	Peanuts, tobacco & products industrial
(4) Liv	vestock	Manure; horse & mule work	Manure; horse & mule work	Manure; horse & mule work	Milk fed to calve eggs used for fan hatching	All anima (excludin sale); wo
Ser	dustry, ervices and utside ac- vities	Fertilizer; tractor & mach. esp.; seeds; pesticides & insecticides; misc.	Fertilizer & lime tractor & mach. esp.; seeds; pesticides & insecticides; misc.	Fertilizer; tractor & mach. esp.; seeds; pesticides & insecticides; misc.	Feed purchased; veterinary exp.; baby chicks; browling esp. elec., mix	
То	otal	$\sum_{i=1}^{5} x_{i1}$	$\sum_{i=1}^5 x_{i2}$	$\sum_{i=1}^5 x_{i3}$	$\sum_{i=1}^{5} x_{ii}$	\ \frac{\sum_{i}}{i}
Prima	ary Inputs					
(6) La	abor	Labor requirement	Labor requirement	X <sub>63</sub> Labor requirement	X <sub>64</sub> Labor requirement	Work of
(7) La	and	X <sub>71</sub> Land use	X <sub>72</sub> Land use	Land use	X <sub>74</sub> 0	Idle, lan proved; be cleare
Total	Gross Input	$\sum_{i=1}^{7} x_{i1}$	$\sum_{i=1}^{7} x_{i2}$	$\sum_{i=1}^{7} x_{i3}$	$\sum_{i=1}^{7} x_{ii}$	

 $<sup>^{</sup>a}$  This is a detailed form used for constructing the  $5\times5$  model of the Northern-Tidewater Area.

Table 2 (continued

	Intermediate flows (con	itinued)		Final Demand		
estock (4)	Industry, services and outside activities (5)	Total	Government	Direct household consumption	Total	Total gross output
X14 sweet pola- to live-	x <sub>18</sub>	∑ x <sub>1j</sub>	y <sub>11</sub> 0	y <sub>12</sub> Irish potatoes; sweet potatoes; vegetables; berries; fruits; nuts & grapes	Y <sub>1</sub> Σ y <sub>1j</sub>	$\sum_{\mathbf{x}_{1j}+\mathbf{Y_1}}^{\mathbf{X_1}}$
x <sub>24</sub> ; grains; age; green protein	x <sub>25</sub> Grain, soybeans, & lespedesa sold out	∑ x <sub>2j</sub>	Y21 Conservation pay- ments; government purchases of grains	Cowpeas; wheat and corn used in farm household	Y <sub>2</sub> Σ y <sub>2j</sub>	$\sum_{\mathbf{X_{2j}+Y_{2}}} \mathbf{X_{2j}}$
x <sub>24</sub> hay; eeds	X <sub>35</sub> Peanuts, cotton, tobacco & forestry products sold for industrial processes	$\sum x_{3j}$	y <sub>31</sub> Government purchases	ys2 Peanuts; firewood	Y <sub>3</sub> ∑ y <sub>3j</sub>	$\sum_{X_3} X_{3j} + Y_3$
x44 d to calve ed for fam	x <sub>45</sub> All animals sold alive (excluding interfarm sale); wool	∑ x <sub>4j</sub>	y41 0	Dairy products; poul- try products; farm slaughter	Y <sub>4</sub> Σ y <sub>4j</sub>	$X_4$ $\sum x_{4j} + Y_4$
x <sub>54</sub> urchasel; ury exp.; icks; brod elec., mix	x <sub>55</sub>	$\sum x_{\delta j}$	y <sub>51</sub>	y 52 0	Y <sub>5</sub>	X <sub>5</sub>
5 X <sub>i4</sub>	$\sum_{i=1}^{5} x_{i5}$	$\sum_{i=1}^{5} x_{ij}$	∑ <sub>i=1</sub> <sup>δ</sup> y <sub>i1</sub>	$\sum_{i=1}^{5} y_{i2}$	\[ \sum_{i=1}^{5}  \text{Y}_{ij} \]	$\sum_{i=1}^{5} X_{ij}$
X64 equirement	Work off the farm	$\sum x_{6j}$	0	0	0	∑ X <sub>6</sub>
X <sub>74</sub> 0	Idle, land to be improved; woodland to be cleared	\( \sum_{x_{7j}} \)	0	0	0	X <sub>7</sub>
7 X <sub>ii</sub>	$\sum_{i=1}^7 x_{i\delta}$	$\sum x_{ij}$	$\sum_{i=1}^{5} y_{ii}$	\sum_{i=1}^{5} y_{i2}	$\sum_{i=1}^{\delta} Y_{ij}$	$\sum_{i=1}^{7} X_{ij}$
er Area.			"	1		1

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and gross income and net returns to each. Actually, the model is no more than an arrangement of statistical data, but it provides a good background for so called "descriptive analysis" of the area. The input-output model for the Northern Tidewater Area of North Carolina appears in Table 3.

More information is obtained when the set of production coefficients [aii] is derived from the model (Table 4). The technology matrix

TABLE 3. INPUT-OUTPUT MODEL OF THE NORTHERN TIDEWATER AREA, N. C., 1954 I. In Terms of Current Prices (thousand dollars)

1			Intermed	liate flow			Final d		
Inputs from sectors <sup>a</sup>	1	2	3	4	5	Total	Govern- ment	Direct cons.	Total gross output
1 2 3 4 5	118 4 0 152 2,293	0 504 10 1,219 4,455	0 2 10 138 2,597	154 4,971 16 20 911	0 11,323 13,635 2,850 0	272 16,804 13,671 4,379 10,256	286 0 0 0	5,227 242 222 4,116 0	5,499 17,332 13,893 8,495 10,256
Total	2,567	6,188	2,747	6,072	27,808	45,382	286	9,807	55,475
Laborb	2,193	2,360	4,040	1,347	2,563	12,503	0	0	12,503
Total gross input	4,760	8,548	6,787	7,419	30,371	57,885	286	9,807	67,978

II. Primary Inputs in Terms of Physical Units

	1	2	3	4	5	Total	Final	demand	Total
Labor <sup>e</sup> Land <sup>d</sup>	3,655	3,933 361	6,733 20	2,245 0	3,204 25	19,770 480	0	0	430

Sectors: 1. Crops for direct consumption
 2. Feed and forage crops
 3. Crops for industry
 4. Livestock
 5. Industry services and outside activities.
 In wages terms (thousand dollars).
 In terms of thousand man-hour units.
 d In terms of thousand acres.

Table 4. Matrix of Production Coefficients, Northern Tidewater Area NORTH CAROLINA, 1954 (aii MATRIX)a

Inputs		Intermediate Flow						
from sectors	1	2	8	4	5			
1	.02142	.00000	.00000	.01809	.00000			
2	.00071	.02906	.00014	.58509	1.10414			
3	.00000	.00057	.00071	.00193	1.32959			
4	.02767	.07035	.00997	.00232	.27799			
5	.41701	.25705	. 18690	.10718	.00000			
aborb	.66479	.22694	.48464	.26428	.31245			
ande	.00433	.02085	.00145	.00000	.00246			

a Derived from Table 3. Errors may appear because of rounding.

b Man-hour inputs per dollar's output.

<sup>e</sup> Acre inputs per dollar's output.

 $([I]-[a_{ij}])$  is the linear homogenous production function matrix derived from this set.<sup>9</sup>

# A Simple Analysis

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5,499 7,332 3,893 8,495 0,256

5,475

2,503 7,978

Total

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The solution of the simple analysis suggested by equations (5) or (5a) shows how changes in final demand (of one or more sectors) affect the amount of total output of each sector. The significance of the magnitude of the solution for an agricultural area is shown below:

1. Changes in demand. Changes in the demand for a certain product, or products produced in the area can be created by general changes in consumption patterns that affect producers<sup>10</sup> or by market expansion for the area's products.

2. Production control programs. The solution provides a measure of the effect of production control programs in one or more sectors on volume of production in other sectors.

3. Changes in government price support programs. The solution will show how increases or decreases in price support of one or more products affect volume of production of all products. Such a solution can be obtained only on the enlarged model where the product with the support price is treated as a separate sector.

# Primary Inputs

A further step in the analysis enables one to project the demand for primary inputs (labor and land, each to be computed separately) induced by changes in final demand.<sup>11</sup> The analysis of primary inputs has a special meaning and importance in the study of an agricultural area:

(1) Labor.

$$X_{n+1} = \sum_{i=1}^{n} x_{n+1,i}$$

is the estimate labor requirements for the various sectors, but only

$$\sum_{i=1}^{n-1} x_{n+1,j}$$

<sup>&</sup>lt;sup>9</sup> For the importance of the technology matrix see R. G. D. Allen, *Mathematical Economics*, London: Macmillan & Co., Ltd., 1957, Chapter 10, pp. 337 and Chapter 11, pp. 353.

<sup>10</sup> Since prices are assumed fixed, only quantity changes created by shifts of the demand curves are considered here, and not quantity changes result from shifts along the demand curves.

<sup>&</sup>lt;sup>11</sup> See procedure outline in J. Balderson, "Models of General Economic Equilibrium," in O. Morgenstern (ed.), *Economic Activity Analysis*, New York: John Wiley and Sons, Inc. 1954, p. 27.

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corresponds to agricultural sectors, while  $x_{n+1,n}$  is "Work off the farm," and might be changed independently of the magnitude of the nth sector. For convenience, let

$$\sum_{i=1}^{n-1} \overline{x}_{n+1,\,i}$$

denote the amount of labor required to meet a new level of final demand and L be the total farm labor force in the area. The following equations give expression to three possible situations that might occur.<sup>12</sup>

I. 
$$\sum_{i=1}^{n-1} x_{n+1,i} < L - x_{n+1,n} \qquad \text{Excess of farm labor force}$$

II. 
$$\sum_{j=1}^{n-1} x_{n+1,j} = L - x_{n+1,n}$$
 Balance in farm labor force (6)

III. 
$$\sum_{j=1}^{n-1} x_{n+1,j} > L - x_{n+1,n}$$
 Deficiency in farm labor force

These equations can serve as a general guide for recommendations concerned with farm labor policies. Consider situation I, which is most likely to occur. One way to solve the problem is by expansion of production. Note that by the assumption of linearity any increase in a sector's production is caused by an increase in all inputs by the same proportion. The analysis shows how such a solution works out:

$$\sum_{i=1}^{n-1} x_{n+1,j} < \sum_{i=1}^{n-1} \bar{x}_{n+1,i} = L - x_{n+1,n}$$
 (6a)

but if the situation is still

$$\sum_{i=1}^{n-1} x_{n+1,i} < \sum_{i=1}^{n-1} \bar{x}_{n+1,i} < L - x_{n+1,n}$$
 (6b)

further production expansion should be considered or other steps should be taken, such as an increase in  $x_{n+1,n}$  (increasing the amount of working of the farm) or decrease in L (moving farm labor force off the farm).

In situation II, no action is needed, and in situation III the opposite actions of I would be appropriate. All decisions regarding sets of actions should correspond to general farm programs of the area.

(2) Land. The analysis allows unlimited expansion of production, but in the agricultural area model even if labor is considered as unlimited because of the ability to transfer labor into the area, land is a limiting factor that allows expansion of production only to a certain level.

<sup>&</sup>lt;sup>12</sup> These equations refer to the balance situation of farm labor all over the year (or any other defined period of time that the model corresponds to); however, it might occur that in a shorter period of time the balance situation will be different because of seasonality demand for farm labor.

The model shows total amount of land used. This amount can be increased only to the extent of all possible double croppings, idle land, land to be improved and woodland to be cleared, but no more. Due to the assumption of linearity, production expansion is limited by the total potential land supply. These limitations can be stated as follows:

$$\sum_{i=1}^{n-1} x_{n+2,j}$$

is the total land used, including double cropping, as it appears in the model

$$\sum_{i=1}^{n-1} \bar{x}_{n+2,i}$$

is the projection of land use, including double crops due to expansion in production. Z and K are double crop coefficients, where Z is the proportion of land presently double cropped and K is the proportion of maximum possible double crop use. The quantity  $x_{n+2,n}$  is idle land, land to be improved and land to be cleared, but assumed to be suitable only for single crops, at least in the first years.

The following equation gives expression to the maximum available land use and states the restriction conditions for the analysis:

$$\sum_{i=1}^{n-1} x_{n+2,j} (1-Z) + K \left[ \sum_{i=1}^{n-1} x_{n+2,j} (1-Z) \right] + x_{n+2,n} \ge \sum_{i=1}^{n-1} \bar{x}_{n+2,i}$$
 (7)

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$$\left[\sum_{j=1}^{n-1} x_{n+2,j} (1-Z)\right] \left[1+K\right] + x_{n+2,n} \ge \sum_{i=1}^{n-1} \bar{x}_{n+2,i} \tag{7a}$$

#### Conclusion

The model, the analysis and the empirical data are subject to criticism. The assumption of linearity sometimes seems to be unrealistic, but in farm management analysis use of linear homogeneous production functions is not new in either budgeting or in linear programming.

Since the production coefficients of the period in which the model is constructed are assumed to apply at the period of application, one is not able to consider technological change in the economy, a point which is quite important in agriculture; however, if technological change could be estimated it could be included.

The division of the economy into a number of sectors is arbitrary and affects the results including the whole picture of interdependent relationships.

Aggregation and disaggregation create special problems and hide many economic facts that might be important. In addition, there exists the ques-

tion of accuracy of the data and of the correspondence of the estimated parameters to the theoretical concepts.

Despite these and many other points of criticism, input-output analysis is a useful technique for handling problems that require a picture of the production function on the aggregate level, and may serve as a guide for policy recommendations regarding resource use.

# DISCUSSION: AN INPUT-OUTPUT ANALYSIS OF A SMALL HOMOGENEOUS AGRICULTURAL AREA

L. T. SMYTHE
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My remarks on this paper fall into two categories because I must comment on the paper itself and on the occasion of its delivery.

Technically, this is a fine paper, of a high professional calibre. It is highly mathematical, which means that it is also abstract. This should not be taken as a criticism, since indeed abstraction represents the necessary simplification without which complicated problems would become impossible to handle. It does mean, that to many of us, that which sounds at first hearing like a good paper may leave us some doubt, which is really doubt of ourselves as much as of the paper. I have been assured by better mathematicians that there is nothing objectionable hidden among the symbols. Any sins are sins of omission and these are by no means serious.

For example, while the assumptions required for the model are listed, the connections between relevant equations and the underlying assumption were omitted. Take for example the assumption of market competition and the set of equations showing the input-output coefficients (a<sub>11</sub>) and the so-called "technology matrix" ([I]-[a<sub>11</sub>]). Actually, it is under the assumption of perfect competition that we can identify the input-output coefficients as technological parameters or ([I]-[a<sub>11</sub>]) as a technology matrix. If market imperfections are introduced in the model we would have to interpret these coefficients or this matrix in terms of two types of parameters—those from the production function and those from demand or supply functions. Recognition of this and similar connections might have been useful.

The other category of remarks really represents some questions regarding how well this session may be accomplishing its objective of encouraging wider participation by graduate students. As things have turned out, the three best papers submitted this year are all in one field, all highly mathematical, and all by advanced Ph.D. candidates. Should we consider, therefore, some kind of stratification process to encourage papers of all kinds, and in particular, entries by the forgotten men of these meetings, the master's candidates?

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# THEORETICAL AND EMPIRICAL APPROACHES TO PROGRAM SELECTION WITHIN THE FEEDER CATTLE ENTERPRISE

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JOHN L. DILLON<sup>®</sup>
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STIMULATED by von Neumann and Morgenstern's, "Theory of Games and Economic Behavior," and a recognition of the importance of risk and uncertainty, much theoretical work has been done in developing a mathematical framework for decision making in economic situations. Some laboratory type experiments have also been made. However, few empirical analyses involving these procedures have yet been published. The mathematical framework appears to have been overemphasized to the neglect of realities, or more fairly, the economists have not kept up with the mathematicians.

This paper considers a real situation. The example shows that for a broad class of situations involving competitive market transactions, the decision problem can and should be posed in a simpler way than as an n-person game. The avenue of presentation in through the decision problems facing an individual farmer in the selection of alternatives within his feeder cattle enterprise in a given season. Direct concern is not given to the total number of cattle to be purchased but to the types of cattle feeding programs and their relative proportions. Given prevailing conditions of uncertainty, the question of total number is more relevant to the relation between the beef and other enterprises. Moreover, the decision models are set up for the planning situation of the farmer and not the specific market situation which he faces when he actually enters a buying or selling market. So far as space permits, empirical data will be introduced to enable comparisons to be made between the assumptions of the mathematical decision structures and the behavior of an actual group of farmers. The data refer to 77 out of 97 owner operators of three years standing between the ages of 30 and 50 in Marshall County, Iowa, who had fed an average of at least 25 feeder cattle in each of the three seasons prior to 1957-1958. Discussions were had with each farmer in June, August and October of 1957 and (by mail) in January, 1958.

The good will of Earl O. Heady and Karl A. Fox made this lucubration possible. With the usual caveat, I am indebted to L. Loftsgard for making my English less English and more American.

<sup>&</sup>lt;sup>1</sup>Satisfactory nonmathematical surveys of this theory are given by R. D. Luce and H. Raiffa, *Games and Decisions*, New York: John Wiley and Sons, 1957, pp. 1-23, and K. J. Arrow, "Utilities, Attitudes, Choices: A Review Note," *Econometrica*, 26 (1), January 1958, pp. 1-23.

<sup>&</sup>lt;sup>2</sup> See, for instance, D. Davidson and P. Suppes, Decision Making, An Experimental

Approach, Stanford University Press, 1957.

But mention should be made of M. Shubik, Competition, Oligopoly, and the Theory of Games, in preparation, 1958.

### The Beef Feeder Decision Problem

Within the feeder enterprise, the general decision problem facing a Midwest farmer who considers a beef feeder operation a part of his usual farm program is as follows. Between July and December he must buy feeder cattle from the western feeder raisers. These cattle will be fattened for sale. This operation may vary in terms of the age and sex of the cattle bought, their purchase weight, quality and date, the feed program followed, the length of the fattening period or selling weight of the cattle, and their quality when sold. A decision has to be made as to which combinations of these variables would be best for him to use. The decision, of course, may be made by default.

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The set of all possible combinations among these factors is infinite. The sensible approach would be to stratify each factor in a manageable and meaningful way. For instance, consider one of the decision factors, purchase weight. To discriminate between programs on the basis of a one pound difference in purchase weight, ceteris paribus, would be meaningless. Such a small difference does not matter. Even if it had some significance, it would lead to an unfathomable number of alternatives. At the other extreme, the comparison of programs without regard to purchase weight would mean neglecting an important variable. Some compromise grouping of the possible alternatives under each decision factor is warranted. In varying degrees, the farmers studied did do this; the typical groupings made for each decision factor are shown in Table 1. Purchase weight, for example, was commonly grouped by 50 pound intervals so that a farmer distinguished five alternative steer calve programs with respect to the purchase weight of the calves. Some farmers made finer distinction and some broader ones, but the pattern of simplification is clear.

However, even with the level of stratification indicated in Table 1, the set of all possible combinations among the decision factors is still unmanageable, being of the order of thousands. Although he could discern that they differed, it would be impossible for a farmer to evaluate so many a ternative feeder programs. The evidence gathered indicates that this set of further reduced by broadening the decision categories relating to the considered by broadening the decision categories relating to the considered over the shorter run of a few years. While the order of this subset of alternatives for short-run consideration is remarkably shall compared to the size of the discerned parent set, as Table 2 indicates, it is in line with what one would expect, given human capabili-

<sup>\*</sup>The selection of this subset was not investigated in detail, but it is certainly a confounded function of experience, information, risk feelings and resource limitations.

Table 1. Farmers Discernment of Alternatives Within the Feeder Cattle Enterprise

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Decision factor	Commonly discerned alternatives within each decision factor	Number of alterna- tives within each decision factor
Age type	Steer calves, heifer calves, yearlings, two year olds	4
Purchase weight	By increments of 50 lb. steer claves: 300 to 550 lb. heifer calves: 300 to 500 lb. yearlings: 550 to 750 lb. two year olds: 800 to 1000 lb.	5 4 4 4
Purchase quality	Medium, good, choice, fancy	4
Purchase date	By months	5
Fattening period	By months steer calves: 8 to 14 months heifer calves: 7 to 12 months yearlings: 6 to 11 months two year olds: 3 to 7 months	6 6 5 5
Feed program	Dry lot Pasture	2 1
Selling quality	Good, choice, high choice, prime	4

ties.<sup>5</sup> While every farmer realized that there was an extremely large number of alternatives, only 5 per cent considered more than five in the short run. For the 17 per cent who had only a single program in mind, the short-run prepurchase decision problem was trivial. Their selection was habitual.

Thus the immediate decision problem facing a farmer within his feeder enterprise before he buys consists in the selection of one or more from a

Table 2. Frequency Distribution of Number of Prepurchase Alternatives Considered by Farmers

No. of alternatives considered	No. of farmers	No. of alternatives considered	No. of farmers
1	13	6	0
2	33	7	2
3	. 14	8	1
4	7	12	1
5	6	Total	77

<sup>&</sup>lt;sup>5</sup> See G. A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information," *Psychological Review*, 63 (2), March, 1956, pp. 81-97.

small number of alternatives. These possible programs are more finely specified in terms of buying factors than for the selling characteristics.

## Game Theoretic Analysis

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For a game theory approach, the basic constructs needed are (1) a number of players with conflicting interests, (2) each player having a number of alternative strategies, so that there is (3) a series of payoffs of ascertainable preference which vary according to the strategy each player selects, (4) the payoffs being known to all the players.

Players are not hard to find for the beef feeder game. They are the feeder raisers who breed the feeders, the beef feeders who fatten them, and the meat packers who buy from the beef feeders. Also, the weather plays a passive role by its influence on the feed situation. While there are only a small number of meat packers, there are a very large number of beef raisers and fatteners. This would imply a very large n-person game, unless coalitions were formed. Coalitions with the weather are obviously ruled out. What of agreements among the other players? It has been argued that coalitions will occur only when knowledge is rather complete.6 If the number of individuals involved is very large, the accumulation and processing of information, even if it were available, would be physically impossible. On these theoretical grounds, coalitions could not be expected among farmer players or between farmers and meat packers. So far as the farmers are concerned there are other obstacles to coalition formation such as the values attached to independence and family farming, although current interest in integrated or contract farming indicates these values may be waning. There is only a small number of meat packers of importance. All have some degree of information about their competitive effects. Hence, coalitions of one type or another between them could be expected. But, as is later shown, it is not necessary to explore these possibilities.

The delineation of a beef feeder's alternatives or strategies is discussed above. In a similar way, strategies could be sketched for a feeder raiser, a fat stock buyer and the weather. But further development of the n-person game formulation is difficult. It is not realistic to say that the payoff to an individual beef feeder is influenced by the action of another individual beef feeder raiser. These other individuals are too numerous. An individual beef feeder's payoff is possibly influenced by an individual meat packer but not vice versa. Even if conflict was strong enough under this scheme to cause payoff variations, the assumption of even subjective full information among all the players is unrealistic. The large n-person

<sup>&</sup>lt;sup>6</sup> M. Shubik, "Information, Theories of Competition, and the Theory of Games," Journal of Political Economy, 60 (2), April, 1952, p. 145.

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game model is therefore rejected as incorrect. However, the clue to a more correct description of the situation is inherent in the n-person formulation.

Not unrealistically, it can be assumed that consumer tastes are given within the planning horizon under discussion. The influence of the meat packer's strategies on farmer payoffs is then primarily determined from the supply side. From the individual beef feeder's viewpoint, the players are then the feeder raisers, considered as a group, and all beef feeders as a group. It is the possible aggregate maneuvers of the beef raisers and beef feeders that are pertinent rather than their possible actions at the individual level. The real world situation indicates that the payoff to an individual beef feeder is influenced by the aggregate action of feeder raisers, beef feeders and the weather. If a farmer chooses a particular market month for his fat cattle, he is at a disadvantage if the majority of other cattle feeders also select the same month.

Given the assumption of no effect between individuals, an individual beef feeder can replace the group of all beef feeders by the group "all other beef feeders." The decision model is thus specified in terms of (1) the alternatives available to the individual beef feeder and (2) the alternatives which may be followed by the feeder raisers in aggregate, all the other beef feeders in aggregate and the weather. This model is not equivalent to assuming a coalition among all beef raisers or other beef feeders. Each individual is still acting independently and each farmer, when considered in his decision-making role, is facing a group partly composed of all other cattle feeders. The opponent is a hypothetical one. Call it Nature. Moreover, it is a passive opponent in the sense that Nature's strategy selection affects the individual farmer but not vice versa. Since it would be impossible for an individual to consider all of Nature's possible alternatives, they must be stratified. Thus one of Nature's alternatives, given the stage of the cattle cycle, might be made up of the following combination: above average feed prospects, feeder raisers holding their cattle for the late fall market and all other beef feeders planning mainly to short feed.

# The Farmers' Conception of Players

To what extent did the farmers think in terms of the model specified above? All recognized the weather as a player. As regards the other players, some information is given in Table 3. This table shows the various ways in which farmers conceived the prepurchase situation in terms of players. Each category is exclusive. Summarization shows that six of the farmers had no conception of an opposition, 32 conceived of an opposition in group terms, 27 in a form involving some grouping and 12 in terms of individuals. The influence of other feeders in some form was recog-

TABLE 3. FARMERS' CONCEPTIONS OF PLAYERS IN THE BEEF FEEDING GAME

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Conception of opponents in addition to the weather	No. of farmer
No conception	6
All other beef feeders individually	0
All other beef feeders as a group	7*
Meat packers as a coalition	4
Meat packers as a coalition sometimes	9
Meat packers as a coalition within markets	9 9 9 9 9 8*
Feeder raisers as a group	9
All other feeders individually, feeder raisers as a group	9
All other feeders as a group, feeder raisers as a group	3*
Meat packers as a coalition within markets, feeder raisers as a group	1*
All other feeders individually, packers individually	3
All other feeders individually, packers in coalition sometimes	6 3
All other feeders individually, packers in coalition within markets	3
All other feeders grouped, packers individually	1*
All other feeders grouped, packers grouped	3*
All other feeders grouped, packers grouped sometimes	3*
All other feeders grouped, packers grouped within markets	
All other feeders individually, packers individually, feeder raisers grouped	2
All other feeders individually, packers in coalition, feeder raisers grouped	3* 2 1
All other feeders individually, packers in coalition sometimes, feeder raisers	
grouped	3
All other feeders grouped, packers individually, feeder raisers grouped	2*
All other feeders grouped, packers in coalition, feeder raisers grouped	4*
All other feeders grouped, packers in coalition sometimes, feeder raisers grouped	2*
All other feeders grouped, packers in coalition within markets, feeder raisers	
grouped	2*
Total	77

nized by 59 of the farmers, of meat packers by 48, and of the feeder raisers by 24 of the farmers. However only three visualized the situation exactly in terms of the theoretical model with a combination of the weather, a feeder raiser group and a group of all other beef feeders constituting the opposition. Nonetheless, with some degree of subjectivity, 31 of the farmers had pictures of the situation approaching the conceived model rather closely. These farmers are indicated by an asterisk in Table 3. To the extent that the postulated model provides a rational frame of reference for decision making, the divergences between this model and the farmers' view as shown in Table 3 indicate one source of deviations from optimal behavior.

# The Payoff Matrix

Before considering the model in an empirical setting, a little must be said of the payoff matrix. It indicates the expected payoff to the farmer for each of his alternatives over the range of nature's alternatives. The over-all payoffs associated with a mixture of the farmer's alternatives can also be calculated from it. If the alternatives considered by the individual beef feeder are  $A_1$  ( $i=1,\ldots,p$ ), and the alternatives available to the

feeder raiser group are  $B_j$   $(j=1,\ldots,q)$ , to the "all other beef feeders" group  $C_k$   $(k=1,\ldots,r)$ , and to the weather  $D_m$   $(m=1,\ldots,s)$ , then the payoff matrix for the prepurchase planning stage may be written as follows:

		Nature's alternatives				
		$(B_1C_1D_1)$		$(B_jC_kD_m)$		(BqCrDs
Individual	A <sub>1</sub>	a <sub>11</sub>		aıw		aıt
				•		
	Ai	a <sub>i1</sub>		aiw		ait
				•		
	$\mathbf{A}_{\mathbf{p}}$	apı		$\mathbf{a}_{\mathbf{pw}}$		apt

Nature's alternatives consist of all possible combinations of alternatives that may be followed by the feeder raiser group, the "all other feeders" group and the weather. There are qrs such combinations. Since the farmer has p alternatives, the order of the payoff matrix at the prepurchase planning stage is p by qrs. Although space does not permit elaboration, it must be emphasized that both the size of the payoff matrix and its elements will change over time. For instance, the particular broad alternative selected (purchased) may be broken into a number of subalternatives. Also Nature's "other feeder raisers" component is no longer relevant after purchase, and at some stage the weather will be known with certainty. Again, as expectations change, the payoffs will change.

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Assuming constant returns to scale, the payoff elements are most conveniently expressed in terms of the expected percentage net return on each  $A_1$  with allowance made for the length of the investment. This makes the elements comparable. The assumption of profit maximization then gives a basis of preference between individual payoffs. Moreover, the real world payoff elements must be recognized as not being single valued. They are stochastic due to price uncertainty and the degree of stratification used by the beef feeder in specifying his own and Nature's alternatives. Thus each element  $a_{1w}$  should be replaced by a probability distribution  $P(a_{1w})$ . If the mean value of this distribution is all that the individual considers, there is no problem. The matrix may then be written in terms of these mean values. The situation becomes much more complicated if higher moments of the payoff distributions are important in deciding between alternatives. Bypassing these difficulties, what bases are there for deciding which alternative (s) to follow?

#### Decision Criteria

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Should Nature's alternatives have known or subjectively estimated probabilities, a decision as to the best strategy can be made on a simple probability basis by selecting the feeder program with the highest expected value over all of Nature's alternatives. Most of the hypothesized mechanical models of decision-making would fit into this framework under such a treatment. However some doubt is expressed as to the use of such mechanical models. On the other hand if Nature's alternatives are considered to have unknown probabilities of being followed, the model specifies a "decision problem under uncertainty" (d.p.u.u.). The remainder of this paper is concerned with the implications of such a d.p.u.u.

Four basic methods of resolving a d.p.u.u. have been suggested. The Wald or maximin criterion treats the d.p.u.u. as if it were a two-person zero-sum game, the best selection being the alternative, or mixture of alternatives if mixed strategies are allowed, which has the maximum minimum pay-off. Nature being passive, this method is extremely conservative. The minimax regret or Savage criterion suggests selection of the one, or more alternatives if mixed strategies are allowed, which minimizes the maximum regret. The elements of the regret matrix are derived from the d.p.u.u. payoff matrix by subtracting the expected payoff from the maximum payoff in the same column.

Laplace's principle of insufficient reason says that since the probabilities attached to Nature's strategies are unknown, they are best regarded as equally likely; that act giving the highest average expected payoff over Nature's alternatives should then be selected. Lastly, Hurwicz's pessimism-optimism criterion takes account of the best and worst payoffs for each of the decision maker's alternatives. With a pessimism-optimism index,  $\alpha$ , lying between 0 and 1, the value of  $\alpha$  times the minimum payoff plus  $(1-\alpha)$  times the maximum payoff is calculated for each alternative. The alternative with the highest such value is the preferred one.

Each of these criteria makes different assumptions about the axioms an optimal decision should fulfill. Hence, each may lead to a different solution. There are no *a priori* theoretical grounds for prescribing one method of solution instead of another. Which is the preferred method depends on the frame of mind of the decision maker.

To gain some idea of the role each of these criteria might play,

<sup>&#</sup>x27;See W. Darcovich and E. O. Heady, Application of Expectation Models to Livestock and Crop Prices and Products, Agricultural Experiment Station, Iowa State College, Research Bulletin 438, February, 1956.

<sup>\*</sup> See G. L. Johnson, "Methodology for Studying Decision Making," Journal of Farm Economics, December, 1957, p. 1218.

<sup>&</sup>lt;sup>o</sup> See R. D. Luce and H. Raiffa, op. cit., pp. 278-298.

farmers were asked for their solution of two d.p.u.u. The first consisted of the following matrix, posed as a within year feeder decision problem with the payoffs as net profit on a fixed outlay. The payoffs were designed so that each decision criteria might give a different solution, as indicated at the right of the matrix.

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		Nature			Solution
$A_1$	2500	3500	0	1500	Laplace
A <sub>2</sub>	1500	2000	500	1000	Wald
A <sub>3</sub>	0	6000	0	0	Hurwicz ( $\alpha \leq 8/9$ )
A.	1500	4500	0	0	Savage

Of the 77 farmers, 36.4 per cent selected the Laplace alternative, 14.3 per cent the Wald (maximim), 5.2 per cent the unrandomized Savage (minimax regret), 6.5 per cent the Hurwicz (pessimism-optimism index) and 37.6 per cent a mixture of strategies. These mixed strategies emphasized  $A_1$ ,  $A_3$ ,  $A_4$ ,  $A_2$  in that order. In explaining their choice, all those farmers who selected either  $A_1$  or  $A_2$  gave the exact theoretical arguments. Those selecting  $A_3$  or  $A_4$  generally stressed that they had a preference for gambling. Those who selected a combination usually explained it as a mixture of gambling and insurance.

The second problem was constructed from data supplied by the farmer. It related to the prepurchase planning stage with the set of prepurchase alternatives outlined in reference to Table 2 being taken as the farmers' strategies. For each of these possible programs the farmer was asked his expectation of the most probable cattle buying and selling price under four alternatives of Nature. These alternatives were the four combinations possible from two broad types of weather and two broad types of action on the part of "all other feeders."

The farmers were immediately asked for their solution of this problem. Three said they would not decide till they were sure of weather conditions. Of the remainder, 29 selected a pure strategy and 43 a mixture of alternatives. Among the latter the number with solutions containing two, three, four and five different feeder programs were 30, five, seven and one, respectively. These farmer solutions could then be compared with the theoretical solutions based on a payoff matrix of expected net returns on the outlay involved. These percentage returns were calculated from the expected cattle price data together with associated cost data for each program. Only the Wald, Laplace and Savage solutions were analyzed since the Hurwicz index,  $\alpha$ , was unknown for most of the farm-

 $<sup>^{\</sup>mbox{\tiny 10}}$  Two farmers could not conceive the problem and are deleted from the following analysis.

<sup>&</sup>lt;sup>n</sup>For reasons of convenience, each farmer was asked to assume the actions of feeder raisers to be "average," a term about which only a few farmers quibbled.

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ers. The Wald and Savage solutions were calculated both with and without mixed strategies being permitted.

A dominant alternative existed for 51 of the 75 d.p.u.u.'s; so for these 51, all the criteria, by selecting the dominant alternative, gave the same solution. The frequent exhibition of dominance was partly due to the small number of alternatives considered, as emphasized in relation to Table 2. It also reflects the feelings of those farmers who did not attach strong differential effects to some or all of the strategies available to the weather and "all other feeders." Had allowance been made for a range of possible feeder raiser strategies, dominance would have been less frequent. Nonetheless, the existence of so many identical solutions implies that theoretical extension of the types of decision criteria may have little practical relevance.

The correspondence between farmer and theoretical program selection is outlined below in terms of number of farmers:

(1) All theoretical solutions identical:	
Farmer's and theoretical solutions identical	20
Farmer's solution overlapping theoretical solution	25
Farmer's solution completely different from theore	tical solution 6
(2) Theoretical solutions not all the same:	
Farmer's solution overlapping theoretical solutions	. 17
Theoretical solution overlapping farmer's solution	5
Farmer's solution completely different from theoret	ical solutions 2
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	and the second second

The 13 farmers who had only a single alternative (Table 2) are all included in the first category of (1). Goodness of fit tests, based on finer breakdown of the above data, indicate that the hypothesis of chance correspondence between the farmer's selection and the theoretical solutions cannot be rejected. Thus it cannot be said that the farmers behaved rationally in terms of the d.p.u.u. model. This does not necessarily imply that they do not think in terms of players and strategies. The data of Tables 2 and 3 indicate that a majority of them did have such conceptions. The difficulty is more likely in the assumption of profit maximization to the exclusion of other factors and in the problem of transforming the expected price structure to expected profit terms.

From the discrepancies between farmer solution payoffs and the payoffs given by the various theoretical solutions, it is possible to determine the increase in the over-all expected profit on a given outlay that would occur if the farmers had followed an optimal solution. Thus if each of the 75 farmers had used the Wald criterion, the profit expected for the whole group would have been increased by 24.6 per cent if only pure strategies were allowed and by 24.1 per cent if mixed strategies were per-

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mitted. The corresponding figures for the Savage criterion are respectively 245 and 24.3 per cent. Under the Laplace method, the increase would have been 24.8 per cent. Of course, there is nothing general about these particular figures; they only relate to a single set of data. But they do provide an example of the economic irrationality that may prevail among farmers in interpreting their own expectations. Whether or not these errors of interpretation are balanced by errors in the expectations is another question. Also, these figures again emphasize the comment made previously that, given the limited number of alternatives considered concurrently by the farmers, differences between the theoretical criteria may be of little practical import.

# DISCUSSION: THEORETICAL AND EMPIRICAL APPROACHES TO PROGRAM SELECTION WITHIN THE FEEDER CATTLE ENTERPRISE

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THE area of decision-making in a world of uncertainty is fascinating to nearly everyone. After all, this is the problem of choice that we face continuously whether we are buying groceries, picking out a new car, or deciding on something as important as a new job. There always seems to be a multitude of alternatives from which to choose and we always have something less than complete knowledge about them.

Dillon has discussed decision-making under uncertainty using some ideas taken from the increasingly popular area called game theory. His paper is a reminder of the necessity to consider such new ideas as they apply to real world problems and the size and number of difficulties we face in trying to make significant progress in using them. Theory needs testing if it is to have relevance. This paper makes a contribution in this area.

One of the many decisions a cattle feeder must make each year is what type of cattle he will feed out and when he will buy them. The primary problem posed by Dillon was not how a farmer should most rationally make this choice, but rather whether game theory has anything to offer in improving choices in this type of situation. This type of problem may be quite valid for a limited amount of research effort. We need to look at new techniques of analysis, see how they work, and find where, if any place, they have application. Many of the newer ideas in mathematical economics have a certain elegance or allure of exactness which make them intriguing at the very least and sometimes very powerful in the

analysis of specific kinds of problems. But applied research normally has its roots in solving real world problems first and using any and all methods available in seeking answers. Looking for ways to use or try out new techniques of analysis is not the primary job of research in agricultural economics.

As Dillon points out, much of the theoretical work in game theory has revolved around the two person, zero-sum type of game. It is assumed here that each player knows enough about his opponent to know as a result how he will move or what alternatives are open to him and what his opponent's best strategy will be. The procedure for making decisions is based on this series of rather important assumptions. While there is uncertainty in respect to which move each opponent may finally make, the effect of this move when made is assumed to be known.

In examining the feeder cattle problem in this setting, one sees some immediate problems. There must be only two players in the game. A payoff matrix must be constructed. That is, the effect of each of the first player's moves on the second, and what he in turn may do must be determined. All the other necessary assumptions to put the decisions of a cattle feeder into this kind of framework must be established.

A solution to the first of these problems has been suggested by facing the individual cattle feeder with one opponent, a hypothetical one called Nature, because there is no other realistic choice which combines weather, total market forces, and the actions of all other cattle feeders into one unit. While such an assumption may seem to some to be very difficult to accept, it is not impossible. It has been generally accepted in theory as necessary and useful. However, the likelihood of Nature knowing what the opponent, the individual cattle feeder, will do or changing

his actions accordingly does seem rather unrealistic.

The most difficult problem in applying game theory to a real world situation for a cattle feeder centers around the assumptions regarding the payoff matrix—how the opponent will play if each of a series of moves is made by the farmer and the alternative moves a farmer may make as a result. The likelihood of ever specifying such a payoff matrix with any degree of accuracy either in terms of mean values or probability distributions for the individual cells is rather remote. This may have seemed so obvious to Dillon that he did not bother to mention it. Yet in appraising applications of game theory to farmer decision making, one cannot overlook this. If a true payoff matrix were established, the choices among the four criteria that a farmer might use in making his final move, maximum likelihood, minimax, maximin, and the optimism-pessimism index, would become much more than academic.

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uncertainty as to an opponent's move but there is usually a known probability distribution of the series of actions he may take. Most of us would have trouble handling all this mentally in making choices as one of the players, but such a situation does seem possible. This is much less likely on a farm.

A few comments about farmer reactions to the payoff matrix may also be appropriate. This part of the study must have been a lot of fun. There was a real challenge to the interviewer in presenting the hypothetical situation to each farmer in a lucid and consistent way. Likewise he must have been curious to see the reaction of each farmer to the situation presented. One cannot help but wonder, however, if the answers a farmer gives when playing such a game would be the same if he were making these choices with his own cattle and money. No one can ever be sure. Perhaps this is the only way one can find out how a farmer might react in a new situation that he has not considered very carefully before. Nevertheless, the results of research with consumer preference surveys should remind us that what consumers say they will do and what they have done when faced with the actual situation are often two different things.

This is not to say that Dillon's explorations were without merit because farmers were asked what they might do instead of what they had done. Rather we should be reminded that conclusions drawn from this kind of game playing must be considered for what they are. If in fact these same farmers had to choose when their own money was at stake the answers might well be different.

How can we learn how farmers will react when faced by something new or different? The biological or physical scientist has always tried to answer this kind of question with a controlled experiment. The human animal is much more difficult to control. We know there will be great variation among individuals. Too many controls may restrict the applicability of results. Perhaps the best experiments are those in which we can observe a group placed in a new situation, without the participants in the experiment being forewarned. This is easier to do in a supermarket than in a type-of-farming area. But it may be equally necessary to get valid results.

In summary, Dillon deserves commendation for his explorations into the uses of game theory in farm decision-making. He drew no strong conclusions from his explorations, nor should we. It appears to this observer that we have more to learn from game theory as an orderly procedure for looking at the process of decision making than as a technique to be used in doing applied research.

### REPORTS AND MINUTES

#### ANNUAL REPORT OF THE PRESIDENT, AFEA

Among the impressions gained or confirmed by the experience of serving as President of AFEA are:

Agricultural economists are independent thinkers. They have varied and vigorous thoughts. The thoughts do not always agree or coincide. Within the spectrum of these thoughts, those who have custody of this Association have wide discretionary latitude and must be prepared to accept responsibility for decisions. Substantiation of this observation was brought out by our questionnaire of last year. We are indebted to R. M. Walsh, G. W. Hedlund and Max Brunk and their associates for analyzing the results of the survey which shows

the unlikely prospect of obtaining unanimity on anything.

Agricultural economists are willing workers. The custodian has ample opportunity to recruit help. Moreover, all of those willing to help are not members of this Association. Wide dispersion of assignments maintains interest and stimulates membership. This conclusion is drawn from the experience of asking literally hundreds of agricultural economists to perform tasks for the Association. To acknowledge all of these helpers by name is not possible, it will suffice to say it was gratifying to note the willingness of those who renewed their memberships in order to do the work in good grace, but it was even more gratifying to approach those who maintained membership in good standing.

Agricultural economists are dispersed throughout the United States and the world. A reliable directory is a very useful tool to an official of this Association who seeks to tap the available personnel resources. We owe a continuing vote of thanks to Karl Brandt, Joe Ackerman, Roscoe Saville and their associates who prepared the directory, and we should anticipate need for

another one within a few years.

Agricultural economists are respected and their views are sought in many quarters of science and the economy. I want to acknowledge the services of Ray Penn, Ray Doll, P. L. Putnam, Henry L. Burkhardt and John D. Rush for attending meetings to which representation from our Association was invited.

Although the numbers of agricultural economists are growing and their sphere of influence is spreading, several economic developments of great import to farmers and society have received little, if any, benefit from their analytical study. Need for a greater range of interest in agricultural economics research is evident. Our Association could well assume responsibility for ferreting out neglected areas and directing attention to them. This view is shared by the National Bureau of Economic Research and Harold Halcrow, our representative on the board of this bureau, may have occasion to discuss this with our officials.

An effort has been made in arranging the program of these meetings to treat several subjects on which there is a paucity of related economic research. We are indebted to several speakers who have had the courage to discuss these subjects for the purpose of provoking interest instead of undertaking the easier task of reporting and appraising research results on more familiar subjects.

We welcome, particularly, our guests from other sciences who, among numerous colleagues invited to discuss developments in their disciplines with us,

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had sufficient breadth of interest to consent to participate in our meetings. By foregoing attention to interests closer to their immediate responsibilities and acceding to our persuasion in lieu of compensation they do us honor. We are indeed grateful for their presence.

I trust our membership may find it possible to reciprocate in any attempt to exchange information and views between us and other sciences. I feel the

liaison with the natural sciences, especially, needs strengthening.

Our relationships with the social sciences continue to improve through the avenue of the winter meetings. Tribute is due to James Honan, Alvar Nixon and Paul E. Hand for their excellent management of local arrangements for the sessions held in Philadelphia last winter. Fred Waugh, Louis Herrmann, Richard Foote and Robert Schwenger, who served on the Winter Program Committee, also deserve commendation. All of these sessions, save one, were held jointly with other Associations and we have had the satisfaction of hearing members of these Associations say that their joint sessions with AFEA were among the best they attended.

John Sitterley is to be commended for recognizing and being willing to do something about a problem concerning our students. Together with Walter Wilcox he is endeavoring to obtain adequate provision for cataloguing on

microfilm abstracts of doctoral dissertations in agricultural economics.

Because of a change in his position Norman Nybroten had to relinquish chairmanship of the Employment Committee he was instrumental in starting. Richard King assumed leadership in carrying on these activities that are prov-

ing of interest to a number of our members.

Several seasoned performers have again served the Association with distinction. They include Walter Ebling and his most active Agricultural Data Committee, Richard L. Kohls and R. B. Wilson on the Audit Committee, Joe Ackerman on the Honors Committee, and William H. Nicholls who will be relinquishing his chairmanship of the Awards Committee. The several subcommittees on awards headed by Herman Southworth, Ronald L. Mighell and A. Gordon Ball have again performed nobly.

The fact that our membership has been maintained despite a rise in dues is attributable in large measure to our excellent Membership committee consisting of Russell Ives, Omer W. Herrmann and the competent chairman, Howard Diesslin. This evidence of continued interest and support of our association is

a source of inspiration to your officers.

A step-up in number of sustaining memberships this year is entirely due to the initiative of Ivy W. Duggan whose interest in this method of aiding our

finances is appreciated.

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In accord with our new Constitution, counting of ballots has been performed prior to the annual meeting. This task has been handled by Charles E. French, Milton M. Snodgrass, and John O. Dunbar who did it in time to prepare the successful candidates for their new responsibilities before assuming them officially at these meetings.

During the year our new *Journal* editor assumed his duties in highly creditable fashion. We may feel assured that this important function is in capable hands. Robert Clodius with Willard Mueller and George Judge and the Editorial Council are issuing a publication in which we may take justifiable pride.

Dr. Henry C. Taylor, serving as chairman of our first Fellows Election Committee, launched the new procedures for honoring our most distinguished scholars and leaders. With the other members of the committee agreeing to

succeed to this post in turn, we may look forward to F. V. Waugh, Asher Hobson, John D. Black and T. W. Shultz maintaining the high standards of selection exemplified by the announcements that are to be made at the Awards and Recognition program. This program affords opportunity to acknowledge in a small way our gratitude and respect for men to whom we owe much.

For development of the subject matter of programs at these meetings, thanks is due to the hard working committee comprising John M. Brewster, Marguerite Burk, Lloyd Davis, Fred Garlock, Nathan Koffsky, N. T. Pritchard, Orlin J. Scoville, Harry A. Steele, Glen D. Simpson, and Robert C. Tetro.

A most delightful part of my tenure has been the experience of working with our Canadian colleagues in preparing for these meetings. They are not so numerous, but they are most resourceful and diligent. Sol Sinclair has marshalled the forces effectively. The entertainment program must be recognized as the more obvious of many fine features engineered by Robert S. Elliot for our enjoyment. For the many other accommodations accorded us we acknowledge with sincere appreciation the contributions of their able lieutenants including A. W. Wood, J. C. Gilson, T. O. Riecken, Lorne Hurd, E. E. Baxter, J. F. Mants, D. H. Treleaven, F. W. Hamilton and the charming ladies Elsie Sinclair, Marjorie Elliot and Betty Wood. To the entire Local Arrangements Committee and to Ralph Campbell and his associates in the Canadian Society, I express heartfelt thanks for the finest cooperation imaginable.

Our Society approaches a new year and a glorious future with its fiscal affairs in good order. The man responsible for this confident status is our loyal Secretary-Treasurer whose devotion to our Association has been expressed most eloquently in plain hard work. We have enjoyed the benefit of services of one of the most capable, congenial, industrious managers with whom I have ever had the pleasure of working. As has been his manner for 4 years, though he plans to discontinue the custom this year, the gentleman will present the essential item on this business agenda next. To the president in need, the friend

indeed, is Lowell Hardin.

HARRY C. TRELOGAN, President, AFEA Ass net in bers, arrang regula

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# REPORT OF THE SECRETARY-TREASURER, AFEA 1957-58

Association membership continues to show gradual growth (Table 1). Our net increase in membership is due primarily to our new classification of members, the Corresponding Members who have come to us under our ICA contract arrangement. It is a credit to our membership activities that numbers of regular members actually increased despite the rise in annual dues.

Table 1. Number of Members and Subscribers, American Farm Economic Association, July 1, 1954-58

Classification	1954	1955	1956	1957	1958	Net change 1957 to 1958
Regular members	1740	1796	1960	1998	2022	24
Corresponding membersa	_	_		_	44	44
Junior members	187	149	284	321	293	-28
II S. libraries and firms	307	269	335	320	316	- 4
Foreign libraries and firms	355	351	425	472	467	- 5
Exchanges	1	1	1	8	15	7
Total	2590	2566	3005	3119	3157	38

<sup>&</sup>lt;sup>a</sup> Per contract with ICA certain foreign agricultural economists who have visited the U. S. become Corresponding members upon recommendation from ICA. These members pay \$2.00 per year and ICA pays \$11.00, for a total Corresponding membership cost of \$13.00 per year.

#### Income and Disbursements

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Association cash receipts and disbursements are presented in Table 2. We continue to carry the costs of our awards program from funds initially obtained for this purpose. Table 2 presents on a cash basis the total operations of the Association. You will note that securities were sold during the year in the amount of \$9,628.92. This was necessary in order to pay for our Directory Handbook and to meet current operating expenses. This move was planned and was budgeted. No re-investment in securities was made during the year.

As compared to last year, 1957-58 receipts for dues and subscriptions were up substantially as a result of increased membership charge. Earnings from dividends and interest were down slightly while *Journal* printing costs continued to rise. The 1957-58 cost of printing the *Journal* is \$4,550.94 higher than it should be for comparison purposes due to the inclusion of the May 1958 issue in this statement. Previously the May issue had been carried on the next year's business.

The Association's net worth in total declined substantially less than the reduction in securities. The Association sustained a loss for the year 1957-58 of \$4,334.29 (Table 3). Had we not paid for the extra May issue of the Journal of Farm Economics, we would have shown a gain for the year's operation. In view of the non-recurring expense for production of the Directory handbook, we feel that the Association has had a good year financially.

#### Balance Sheet

When all marketable securities are valued at cost, the net worth of the Association decreased \$4,334.29 in 1957-58 (Table 3). If market value of the

TABLE 2. AMERICAN FARM ECONOMIC ASSOCIATION SCHEDULE OF CASH RECEIPTS AND DISBURSEMENTS FOR YEAR ENDING JUNE 30, 1958

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Cash Balance, June 30, 1957		\$ 4,184.78
A.F.E.A. dues and subscriptions	\$27,179.31	
W.F.E.A. dues	625.50	
C.A.E.S. dues.	457.70	
I.C.A. dues.	1,808.00b	
Sale of back issues	1,093.25	
Sale of reprints	1,388.86	
Advertising	1,211.50	
Annual meeting	1,359.58	
Interest	715.99	
Dividend	2,209.32	
Sale of fractional shares and stock rights	94.59	
Miscellaneous revenues	166.77	
Savings bonds cashed.	1,678.00	
Sale of marketable securities	7,950.92	
Borrowed money.	12,000.00	59,939.20
Disbursements:		
Journal printing	\$27,078.744	
Editing fees	1,480.00	
Reprints	1,321.890	
Purchase of back issues	91.00	
Awards program	2,981.89	
Annual meeting expenses	2,458.47	
Postage and telegrams	579.77	
Office supplies	623.25	
Subscription refunds and miscellaneous	440.01	
Directory handbook	4,649.19	
W.F.E.A. dues	625.00	
C.A.E.S. dues	457.70	
Bank charges	4.65	
Interest	130.97	
I.C.A. membership promotion.	143.70	
Repayment of borrowed money	12,000.00	55,066.2

<sup>a</sup> Includes seven sustaining memberships at \$100 each as follows: Northwestern Mutual Life Insurance Co.; Foremost Dairies, Inc.; Equitable Life Assurance Co. of N. Y.; Calcot Ltd., California; Ralston Purina Co.; International Harvester Co.; Trust Company of Georgia Associates.

b Largely pre-payment of three-year Corresponding Memberships under new ICA contract

• Includes \$650 for advertising in Directory Handbook.

d Includes payment for May 1958 issue (\$4,550.94) previously carried in next year's business. Thus poid for arter issue

ness. Thus paid for extra issue.

• Reduction due to new policy of no free reprints.

securities were used both at the beginning and end of the year, the decrease in net worth would have been slightly greater. When the assets of the Association were divided between general accounts and the accounts of the special grants or awards activities, net worth of the Association exclusive of special grants activities was \$53,536.91, down \$1,552.36 from a year earlier (Table 4). Again this calculation was obtained by valuing securities at cost.

#### Special Grants Fund

In its special grants fund used for the awards programs, the Association had a balance of \$5,216.55 (Table 5). Expenditures in this program last year totaled

TABLE 3. AMERICAN FARM ECONOMIC ASSOCIATION BALANCE SHEET, JUNE 30, 1958

ASSETS	
Cash	\$ 9,057.79
Investments: Treasury bonds at cost	
(quoted value 6/30/58 \$21,965.66) \$24,045.54 Marketable securities at cost	
(quoted value 6/30/58 \$52,151.88)	51,000.67
	\$60,058.46
LIABILITIES AND NET WORTH	
Deferred Credit:	
Deferred Credit: Prepaid membership dues	\$ 1,205.00
Deferred Credit: Prepaid membership dues Net Worth:	\$ 1,205.00
Deferred Credit: Prepaid membership dues Net Worth: Balance June 30, 1957 863,187.75	\$ 1,205.00
Deferred Credit: Prepaid membership dues Net Worth: Balance June 30, 1957	
Deferred Credit: Prepaid membership dues Net Worth: Balance June 30, 1957 863,187.75	\$ 1,205.000 58,853.46
Deferred Credit: Prepaid membership dues Net Worth: Balance June 30, 1957	

Largely ICA memberships; 2 years of 3-year subscriptions yet to run.

Table 4. American Farm Economic Association Net Worth Exclusive of Special Grants Funds, June 30, 1958

	\$58,853.46
\$5,216.55	
100.00	5,316.55
	\$53,536.91
	\$5,216.55 100.00

Table 5. Transactions and Balance in Special Grants Fund, 1957–58, American Farm Economic Association

Beginning Balance and Income Balance, first of year. \$" Interest earned	7,998.48 199.96	
Total		\$ 8,198.44
Disbursements Awards and direct expense of program	2,981.89	2,981.89
Ending Balance		\$ 5,216.55

2,981.89 . Interest income of \$199.96 (2½ per cent of the beginning balance of \$7,998.48) was assigned to the fund.

### Summary

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This financial report is fairly favorable. In analyzing it we should keep the following in mind:

1. The full impact of the change in dues has not yet been felt. If we retain

or gain membership, income from dues will rise again next year without further changes in dues.

2. The ICA contract revenue is a temporary proposition.

3. The status and future of sustaining membership revenue is uncertain (\$700 revenue in 1957-58).

4. Directory Handbook expenditures and income are non-recurring items.

5. At the present rate, our balance in the Special Grants Fund will be ex-

hausted in two more years.

6. Certain costs will be incurred this year in the transfer of the office of Secretary-Treasurer to Cornell University.

7. We have caught up with billings for Journal publication and are now current.

On balance in the absence of new or expanded AFEA programs which involve new expenditures, it appears that we are near the break-even point with the present dues and membership structure. Another year's operation under the

present \$9 membership rate is needed to clarify our situation.

This has been an eventful, productive and satisfactory year in the office of the Secretary-Treasurer. Several outstanding projects were brought to completion and the new program involving Corresponding Members was launched and is now operating smoothly. As in previous years the above account of cash expenditures on the part of the Association falls far short of reflecting the total inputs involved in conducting the affairs of AFEA. To the many individuals and institutions who have contributed directly and indirectly to this successful year's operation, we express our appreciation.

LOWELL S. HARDIN Secretary-Treasurer, AFEA

# REPORT OF THE AUDITING COMMITTEE, AFEA

Upon the request of the officers of the Association we have examined the accounts and statements prepared by the Secretary-Treasurer, Lowell S. Hardin

for the period July 1, 1957 to June 30, 1958.

We have verified the income statement against the gross totals of the receipts journal and the disbursement statement against the gross totals in the disbursement journal. We also verified the individual entries in the disbursement journal and the individual deposit entries in the receipts journal against the check-book record. The June 30, 1958 statement of cash on hand agrees with the recapitulated bank statement of that date. We have checked the actual inventory of securities against the reported securities record.

We find the Treasurer's report accurately reflects his records of the transactions and financial position of the Association. All records and books are being

kept in a very neat and understandable manner.

R. L. KOHLS R. B. WILSON

# REPORT OF THE EDITOR

#### JOURNAL OF FARM ECONOMICS

During the past year the editorial offices were transferred from the University of Connecticut to the University of Wisconsin, and with the help of a great number of people, the *Journal* continues to make its regular appearances. The current acceptance rate is about 50 per cent of the manuscripts submitted

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for publication. A substantial number of those published have been shortened or revised as a result of review by the editorial staff. As in the past, all contributed manuscripts are reviewed by at least two persons. This has involved a great deal of effort on the part of members of the Editorial Council.

Liberal use has also been made of outside reviewers whose time and interest is greatly appreciated. In addition to the considerable services contributed by members of the staff of the University of Wisconsin, outside reviewers include: John Mellor, Cornell University; Ayres Brinser, Harvard University; Byron O. Marshall, Jr., Johns Hopkins University; John McCoy and Wilfred H. Pine, Kansas State College; L. John Kutish, Marquette University; Raleigh Barlowe, B. C. French, Clifford Hildreth, and Lawrence Witt, Michigan State University; Richard King, and Lee Martin, North Carolina State College; Adlowe Larson and Leonard T. Miller, Oklahoma State University; G. E. Brandow and Robert Hutton, Pennsylvania State University; Richard Kohls, Purdue University; George B. Alcorn, Norm Collins, Jerry Foytik, S. S. Hoos, George Kuznets, Ivan M. Lee, Chester O. McCorkle, George Mehren, J. M. Tinley, Loy Sammett, and Russ Shaw, University of California; Irving Fellows, Stewart Johnson, and Stanley K. Seaver, University of Connecticut; C. B. Baker, University of Illinois; A. N. Halter and L. H. Heller, University of Kentucky; Lee Day, University of Minnesota; James Rhodes, University of Missouri; Don Kanel, University of Nebraska; Wilfred Candler, University of New England, Australia; Arnold Zellner, University of Washington; Paul W. McGann, U. S. Bureau of Mines; John M. Brewster, Marguerite C. Burk, and Joe Motheral, U. S. Department of Agriculture; Donald R. Murphy, Wallaces' Farmer and lowa Homestead; Marion Clawson, Resources for the Future, Inc.; Montague Yudelman, Rockefeller Foundation; and Mary E. Amend, Land Economics.

Among reviewers from the U. S. Department of Agriculture were the following: Bill Addison, Warren Bailey, R. O. Bausman, Harold Breimyer, J. B. Claar, Chlorus Crickman, Wayne Ehlers, Gerald Engelman, Richard Foote, Robert B. Glasgow, Louis Herrmann, Donald Iback, Hugh Johnson, Frank Maier, Trienah Meyers, Walt Miller, Paul Mohn, Terrence W. McCabe, Marc Nerlove, Kenneth E. Ogren, Bill Pendleton, C. Kyle Randall, Mark Regan, Anthony Rojko, Louis Upchurch, Willard Williams, Hugh Wooten, and Gene Wunderlich.

Willard F. Mueller as Associate Editor, and George G. Judge as Book Review Editor deserve special mention for their services. Finally, the Editor wishes to express his thanks to all named persons and others without whose cooperation there would be no Journal of Farm Economics.

ROBERT L. CLODIUS, Editor, AFEA

# REPORT OF THE ELECTION TELLERS

The 1958 Tellers committee counted the ballots with the following results:

> Tyrus R. Timm, Chairman Teller's Committee, AFEA

# REPORT OF EMPLOYMENT COMMITTEE, AFEA

The Employment Committee established in 1955 has confined its activities to the annual summer meetings at which time a file of employment opportunities and a file of prospective applicants are made available to persons attending the meetings.

These files have been in frequent use both at Lake Junalaska and here in Winnipeg, although not all positions are listed and not all job applicants make use of this service. Approximately 20 positions and some 30 personnel data

forms are currently on file in Room 101, Agriculture Building.

While it is true that a rather small portion of all appointments in the field are the direct result of Employment Committee activities, several comments have been made expressing appreciation for a place at which negotiations may be opened at annual meeting time. In view of the rather small investment needed to provide this service, it is my recommendation that the committee's work be continued.

RICHARD A. KING, Chairman Employment Committee, AFEA

# REPORT OF THE RESOLUTIONS COMMITTEE, AFEA

Bennett S. White, Chairman of the Resolutions Committee, moved the adop-

tion of the following resolution:

RESOLVED, That the membership of the American Farm Economic Association meeting jointly with the Canadian Agricultural Economics Society at Winnipeg, Canada, August 20-22, realizing that the task of arranging for meeting places, housing, entertaining, and generally caring for such a large number of visitors has imposed a heavy burden upon a small number of devoted people, expresses its appreciation and gratitude to the persons and organizations contributing to making these meetings successful:

To Sol Sinclair, General Chairman; R. S. Elliot, Vice-Chairman; and A. W. Wood, Secretary; for the over-all job of planning and general direction of

arrangements;

To Bob Elliot who has worked tirelessly in enlisting the cooperation and support of numerous community and business organizations;

To J. C. Gilson and the members of the Accommodation Committee for the

successful billeting of approximately 1,000 people;

To Bob Elliot and T. O. Riecken, Co-Chairmen, and the other members of the Committee on Entertainment and Convention Facilities;

To Mrs. Sinclair, Mrs. Elliot, and Mrs. Wood and the other members of their committee for arranging a pleasant and entertaining program for the ladies; To Lorne Hurd and his Committee on Printing and Publicity;

To E. E. Baxter, J. F. Mants, and D. H. Treleaven, Co-Chairmen, and the other members of the Reception, Registration and Local Transportation Com-

To the Committee on Tours, F. W. Hamilton, Chairman; and be it

RESOLVED further, That the membership expresses its deepest appreciation to the University of Manitoba, the government of the Province of Manitoba, and the business and civic community of Winnipeg for the time and resources which they have contributed and the generous hospitality afforded;

RESOLVED further, That those who have been responsible for arranging

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nom if no the the this conference may take satisfaction from the knowledge that they have not only provided those in attendance with a stimulating experience, but also have made a contribution to international understanding and good will; and be it RESOLVED further. That the policy of holding an occasional joint meeting

of this kind should be continued.

The resolution was unanimously approved.

#### RESOLUTION

Bennett S. White then moved the adoption of the following resolution:

RESOLVED, The membership of the American Farm Economic Association commends and congratulates Harry Trelogan and the other officers, committee chairmen, and committee members for the long hours of effort, most of them contributed after a full day's work at a regular job, which have made possible these successful meetings and a year of activity which has brought a further strengthening of the membership and influence of the Association; and be it

RESOLVED further, That we especially thank Lowell S. Hardin, who at considerable personal sacrifice, has faithfully and effectively discharged the duties of Secretary-Treasurer, and we express our appreciation to Purdue University for its convertion in this regard

versity for its cooperation in this regard.

The resolution was unanimously approved.

Bennett S. White, Chairman

Resolutions Committee, AFEA

# REPORT OF THE SUBCOMMITTEE ON STUDENT ACTIVITIES

The subcommitte on student activities is pleased to report that the past year has shown increased activity, improved organization and greater interest and

performance than previously.

Graduate student competitions are announced in January in combination with announcements of AFEA Awards for Research in Agricultural Economics. This procedure has systematized the competition for papers submitted by graduate students and should be continued. Having members of this subcommittee serve as judges has worked well. An institution is allowed to submit only one graduate student paper. This year six institutions submitted papers. They were: Iowa State College, Michigan State University, North Carolina State College, Ohio State University, Purdue University, and University of Kentucky. The three winning papers were from Iowa State College, North Carolina State College and Purdue University.

Five institutions have indicated that they will enter a team in the undergraduate debate competition: "Resolved, that a two-price system for disposal of surplus agricultural products at home and abroad contributes to a stable domestic agricultural economy." Seven institutions have indicated that they will enter one or more contestants in the undergraduate public speaking contest.

A total of nine or ten participants in public speaking are expected.

During the past year the chairman of this committee communicated with every institution in the United States and Canada teaching agricultural economics to determine whether the local student club was already chartered and if not encouraging them to seek a charter. Literature was included describing the advantages of becoming associated with AFEA and details were given on the procedure for obtaining a charter. The results were rewarding. It was found

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that three institutions that had years ago fulfilled the requirements had never been issued a charter. They were: Purdue University, University of Wisconsin and University of Illinois. Arrangements were made to provide them with a charter. In addition, seven other institutions have become chartered since August 1957. They are: University of Massachusetts, University of Georgia North Dakota State College, University of Maryland, Ontario Agricultural College, University of Minnesota and New Mexico College of A. & M. A. Several other institutions have indicated their intention to seek a charter soon.

The Ontario Agricultural College has the distinction of being the first chartered institution in Canada.

There are now 32 chartered student sections of AFEA. They are:

- 1. Ohio State University
- University of Tennessee
- 3. North Carolina State College
- 4. Alabama Polytechnic Institute
- University of Florida
- 6. Mississippi State College
- 7. Virginia Polytechnic Institute
- 8. Louisiana State University
- 9. Iowa State College
- 10. Kansas State College
- 11. Michigan State University
- 12. University of Nebraska
- 13. Oklahoma A. & M. College
- 14. Texas A. & M. College
- 15. University of Kentucky
- 16. University of Arkansas
- 17. Clemson Agricultural College
- 18. University of Missouri
- 19. Pennsylvania State University
- 20. University of Utah
- 21. Rutgers University
- 22. South Dakota State College
- 23. University of Wisconsin
- 24. Purdue University
- 25. University of Illinois
- 26. University of Massachusetts
- 27. University of Georgia
- 28. North Dakota State College
- University of Maryland
- 30. Ontario Agricultural College
- 31. New Mexico College of A. & M. A.
- 32. University of Minnesota

Since we now know what institutions are really chartered (and make regular contacts with them) and those that are not, our records are more complete, our system improved, and interest among students and advisors (Senior members of AFEA) has increased.

The national student officers compile and distribute three newsletters to the chartered sections during the year. These involve much work and are very commendably done. The AFEA defrays the cost of issuing the SS-AFEA newsnever

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letter at an estimated cost of \$75.00 per year. Total cost has not yet exceeded this amount but may in future years due to the increased number of chartered institutions and rising costs.

The AFEA also provides funds estimated from \$75-\$85 to finance awards to winners of undergraduate competitions.

It is recommended that the AFEA continue to provide these funds for awards and the newsletter.

This year a real improvement was made by having President Trelogan include in the program the names of the three graduate students who will present their winning papers at this annual meeting. The title of their papers and a discussant of each was also shown in the program. It is hoped that this will indicate a greater interest in these graduate students and result in larger attendance at the presentation.

Attendance is still poor at all student events and one of our major problems yet to be overcome. Additionally, in the undergraduate debate contest, the task of getting judges is extremely difficult.

This committee believes that the student activities are a vitally important function of AFEA.

A. GORDON BALL, Chairman Subcommittee on Student Activities, AFEA

# REPORT OF THE AGRICULTURAL DATA COMMITTEE, AFEA

The Agricultural Data Committee of the Association has had two meetings during the past year. One at Junaluska, North Carolina, August, 1957 and one at the time of the joint meeting of the Association with the American Economic Association at Philadelphia in December, 1957.

The Chairman of the committee has served on the Census Advisory Committee for agriculture and also on the Census Population Council. In this capacity five meetings of the Census Advisory Committee on Agriculture were attended in Washington and two of the Population Council, Several important changes are taking place in the Agricultural Census.

- 1. For the first time the Agricultural Census will be separate from the regular 10-year Population Census. The Census of Agriculture will be taken in October of 1959 and the Census of Population in April of 1960.
- 2. The definition of a farm for the next Census has been changed. A farm in the 1959 Census of Agriculture will consist of 10 acres of land with \$50 of sales of farm products, or holdings of less than 10 acres of land if they have \$250 worth of sales of farm products. It is expected that data will be collected on the farm units so that a number of farms comparable with that of 1954 can be determined.
- 3. Farm population will be enumerated in the regular Census in April, 1960, and the new definition of a farm will be used in determining whether people reside on a farm. This will eliminate some rural nonfarm people who previously have been counted in the farm population and also some farm people who live in urban areas.
- 4. Sampling similar to that of the enumerations of 1950 and 1954 in the Census of Agriculture will be done in 1959 and in addition a sample of 10,000 farms is planned for October, 1960—a year after the Census of Agriculture.

The committee has continued to work through subcommittees:

 The subcommittee on Agricultural Data Needs in Extension work of which Dr. Dorris D. Brown is Chairman had no formal meetings but Dr. Brown has worked with certain individuals in the U. S. Department of Agriculture and in Congress in an effort to carry forward parts of the work previously reported.

The subcommittee dealing with Data Requirements for Outlook and Marketing presented a section of papers at the meeting of the Association

a year ago and has had no formal meeting since then.

3. At the request of the Executive Committee a year ago, a subcommittee on, "Agricultural Data Needs of Research Workers," was established. The following persons were asked to serve on this subcommittee:

> Kenneth L. Bachman, Chairman Philip M. Raup George Aull George Montgomery George T. Blanch R. J. Penn, Vice President, Ex-officio

The new subcommittee has been unable to have formal meetings until this conference because the members are widely separated geographically and the fact that some of them are on foreign assignments. It seems clear from work done so far that there is no general over-all method to provide the data needed by research workers since such needs are usually associated with specific

projects and hence the needs cannot be anticipated.

At the invitation of the Chairman of ECOP, the Chairman of the Data Committee met with Extension Leaders at Denver in November, 1957 and with a joint ECOP-ESCOP subcommittee on agricultural data. Extension leadership is interested in the maintenances of the 5-year Census of Agriculture about which there has been some question since it has been proposed that the quinquennial numeration might be given up and the funds used to take an annual sample Census of Agriculture to provide mainly national trends.

A panel of papers sponsored by our committee under the title, "Meeting Current and Area Data Requirements in a Changing Agriculture," was given at this conference. The papers reviewed developments in both Canada and the United States. For the Association's annual meeting at Cornell next year, the committee expects to have a panel of papers in the general area of "Agri-

cultural Data Requirements By Research Workers."

While progress has been made during the past year, the work of the committee is unfinished and we hope to make further headway in the next year and it is recommended that the Committee be continued for the next year.

Consultants: O. V. Wells, Ray Hurley, J. D. Black, Joseph Ackerman. Committee Members: J. C. Bottum, Dorris D. Brown, George Aull, Emery C. Wilcox, Philip M. Raup, F. V. Beck, George Montgomen, George T. Blanch, Kenneth Bachman, Walter H. Ebling (Chairman)

WALTER H. EBLING, Chairman Agricultural Data Committee As (

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# REPORT OF THE CHAIRMAN, AWARDS COMMITTEE, AFEA

This is the third year during which all of the varied awards activities of the Association have been conducted under a single over-all Awards Committee.

As Chairman of this committee, it has been my responsibility to coordinate the activities of the several subcommittees and to serve in a general administrative capacity. Except for myself, all other members of the Awards Committee were also members of four special subcommittees, each of whose chairman and members were also appointed directly by President Trelogan. These four subcommittees—on Published Research, on Doctoral Theses, on Graduate Student Papers, and on Journal of Farm Economics articles developed their own standards for weighing the merits of works within their respective jurisdictions, reached a consensus on those works which most merited awards, and then notified me of their findings.

The chairmen and members of these four subcommittees not only performed their difficult assignments conscientiously and diligently but without exception met their deadlines, greatly facilitating the fulfilment of my own responsibilities in preparing for the awards ceremony at Winnipeg. My own contributions were largely limited to administering the printing and distribution of the announcements and the preparation for presentation of the award certificates. Hence, the remainder of this report is based upon the reports to me of the chairmen of the several subcommittees.

# 1. Awards for Published Research Reports

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According to the announcements distributed in February, 1958, the rules for submitting published research were set forth as follows:

- 1. Three \$250 awards, each in a different field of agricultural economics, will be made for publications including bulletins, articles, pamphlets, and monographs (textbooks are ineligible) classified in the following categories:
  - (a) Farm management and production economics
  - (b) Agricultural marketing
  - (c) Agricultural prices
  - (d) Agricultural finance
  - (e) Land and water economics and conservation
  - (f) Theory and methodology
  - (g) Agricultural policy
  - (h) General agricultural economics
- 2. Persons submitting items should indicate the field in which they believe the reports should be classified.
- 3. Selections will be made from published research bearing the publication date of 1957.
- 4. Eligible recipients must be less than 41 years of age at the time of publication.
- 5. Members of the Awards Subcommittee for Published Research will not be
- eligible to submit papers of their own.

  6. Each published report may receive only one award presented by the American Farm Economic Association in 1958. An entry may, however, be considered as eligible for more than one of the following types of awards:

  (a) Best article appearing in the *Journal of Farm Economics*; (b) Published research; and (c) Ph.D. theses.
- 7. Nine copies are requested of each publication submitted for consideration. Fewer copies will be accepted in such cases as articles appearing in national

journals available to the judges. In no event should less than three copies be sent.

8. The Awards Subcommittee for Published Research will consist of nine persons, in addition to the Chairman, representing the various designated fields. The members of the Subcommittee, all of whom will serve as judges, are:

J. Carroll Bottum, Purdue University
Max E. Brunk, Cornell University
Marion Clawson, Resources for the Future, Inc.
Earl O. Heady, Iowa State College
W. E. Hendrix, U. S. Department of Agriculture
Sidney S. Hoos, University of California
William O. Jones, Stanford University
Lawrence W. Witt, Michigan State University
Elmer J. Working, Washington State College

 Publications should be sent directly to the Chairman of this Subcommittee, Herman M. Southworth, Department of Agricultural Economics and Rural Sociology, Pennsylvania State University, University Park, Pennsylvania, on or before March 15, 1958.

#### **Procedures**

Thirty-four published research reports (23 per cent fewer than last year) were received and classified by subject matter as indicated by the authors. (Three additional reports were declared ineligible, two because they were submitted after the published deadline, the third because it reported research for which a Ph.D. Thesis Award had been conferred in a previous year.) Of the 34 reports, 11 were in the field of Agricultural Marketing, 7 in Farm Management and Production Economics, 3-4 each in Agricultural Policy, Agricultural Finance, Theory and Methodology, and General Agricultural Economics, only one in Land and Water Economics and Conservation, and none in Agricultural Prices.

Each of the judges received all reports in the subject-matter field for which he was responsible and recommended those which he considered qualified for the final judging. Of the 34 reports, 13 survived this preliminary screening and were read and rated by all members of the subcommittee on the basis of a standard score-sheet and reporting form. Even so, the ratings by the several judges were quite divergent and, as in previous years, the Chairman of the Subcommittee again expressed some uneasiness about the effects of the application of penalties for joint authorship upon the final rankings.

# Recommendations for Awards for Published Research

On July 18, 1958, Chairman Herman M. Southworth officially notified me of the following results (in alphabetical order) of the deliberations of the Subcommittee on Published Research:

# For Awards of \$250 each:

To ZVI GRILICHES, of the University of Chicago, for his journal article, "Hybrid Corn: An Exploration in the Economics of Technical Change," Econometrica, Vol. 25 (1957), pp. 501-522. (Submitted in the field of Theory and Methodology)

To DALE E. HATHAWAY, of Michigan State University, for his paper,

"Agricultur Policy Nove Generator

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Rona searc "Agriculture and the Business Cycle," submitted to the Subcommittee on Agricultural Policy, Joint Committee on the Economic Report, and published in *Policy for Commercial Agriculture*, Joint Committee Print (85th Cong., 1st Sess., November 22, 1957), pp. 51-76, Washington, 1957. (Submitted in the field of General Agricultural Economics)

To BORIS C. SWERLING, of Stanford University and the Council of Economic Advisers, for his research monograph (with Vladimir P. Timoshenko), The World's Sugar: Progress and Policy, Stanford University Press, 1957. (Submitted in the field of Agricultural Economics)

For Honorable Mention:

To E. M. BABB, of the Eastern Milk Producers Cooperative Association, Syracuse, New York, and

To W. T. BUTZ, of Pennsylvania State University, for their research bulletin, Improving Fluid Milk Distribution Practices through Economic-Engineering Techniques, Pennsylvania Agricultural Experiment Station, Bulletin 622, June 1957. (Submitted in the field of Agricultural Marketing)

To WILLIAM R. HENRY, of North Carolina State College, and

To CHARLES E. BISHOP, of North Carolina State College, for their bulletin, North Carolina Broilers in Interregional Competition, A. E. Information Series No. 56, Department of Agricultural Economics, North Carolina State College, February 1957. (Submitted in the field of Farm Management and Production Economics)

#### 2. Awards for Doctoral Theses

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According to the announcements distributed in February, 1958, the rules for submitting doctoral theses were set forth as follows:

1. Three \$250 awards will be made for theses prepared by candidates for the Ph.D. degree in any department of Economics or Agricultural Economics.

2. An entry must be submitted by the head of the department to which the thesis was presented in partial fulfillment of requirements for a degree. No department may submit more than one thesis for consideration.

3. Selections will be made from those presented to a graduate school faculty

during the calendar year 1957.

4. A published thesis may be entered in both the published research and

thesis classes but will be eligible for only one award.

5. Only one copy of an unpublished thesis will need to be sent to the Committee Chairman for consideration. If 2 or 3 are available it will expedite the judging. All copies will be returned after they have been read by the judges.

6. The Awards Subcommittee for Theses will consist of three persons, in addition to the Chairman. These three persons, all of whom will serve as judges, are:

John M. Brewster, Agricultural Marketing Service George G. Judge, Oklahoma State University Geoffrey S. Shepherd, Iowa State College

7. Theses should be sent directly to the Chairman of this Subcommittee, Ronald L. Mighell, Production Economics Research Branch, Agricultural Research Service, Washington 25, D.C., on or before March 15, 1958.

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#### **Procedures**

Seven institutions (only half as many as a year ago) submitted entries to the Subcommittee on Ph.D. Theses. The seven theses were examined by all three judges and their appraisals were consolidated into a final rating under the supervision of Chairman Ronald L. Mighell, who did not himself participate in the judging. Despite the disappointingly small number of entries, Chairman Mighell reported that the high caliber of the three top theses warranted our making the three awards as previously announced. However, he recommends that hereafter we announce that the judges may at their discretion make only two awards if fewer than eight theses are received. The judges were unanimous in their choice of the three best theses submitted this year but felt that they were sufficiently superior to the other four theses submitted so that no "honorable mentions" were in order.

#### Recommendations for Awards for Doctoral Theses

On June 6, 1958, Chairman Ronald L. Mighell officially notified me of the following recommendations (in alphabetical order) of the Subcommittee on Ph.D. Theses:

#### For Awards of \$250 each:

To WILFRED V. CANDLER, for his dissertation, Linear Programming with Stochastic Yields, Iowa State College, 1957.

To WILLIAM A. CROMARTY, for his dissertation, Economic Structure of American Agriculture, Michigan State University, 1957.

To MICHAEL NELSON, for his dissertation, Economics of Increased Hay Production by Use of Nitrogen Fertilizer on Mountain Meadows in the Harney Basin, Oregon, Oregon State College, 1957.

# 3. Awards for Graduate Students' Contributed Papers

#### Dula

 Three awards will be made for papers submitted by graduate students of any department in the United States engaged in training agricultural economists at the graduate level.

2. Each award shall consist of the cash equivalent of round-trip bus fare from the student's graduate institution to the 1958 Annual Meeting at the University of Manitoba, Winnipeg, Canada; a \$25 subsistence allotment; and 100 free reprints of the paper as published in the Proceedings Number of the Journal of Farm Economics.

3. The student shall be free to choose the subject for his paper, which must, however, be in the area of agricultural economics and shall be limited to 20 minutes' reading time or 9-10 pages of double-spaced typed manuscript.

4. Each department may submit only one paper, selected by a committee of that department. Papers with joint authors are not acceptable.

5. Department heads shall decide which persons qualify as "graduate students." However, full-time staff members working on a degree at their home institutions shall not be eligible.

6. Each department head shall notify Chairman A. Gordon Ball of Iowa State College by March 15, 1958, if his department expects to submit a graduate student's paper.

7. The winners of the three awards will be notified by June 15, and will be

expected to read their papers at the Annual Meetings at Winnipeg, Canada. Their papers will be published as part of the Proceedings of the 1958 Annual Meetings.

8. The Awards Subcommittee for Graduate Students' Contributed Papers will consist of four persons, in addition to the Chairman, all of whom will serve

James C. Gilson, University of Manitoba Harlow W. Halvorson, University of Wisconsin Roland J. Hildreth, Texas A. & M. College Walter H. Pierce, North Carolina State College

9. Five typed copies of each paper shall be sent directly by departments to the Chairman of this Subcommittee, A. Gordon Ball, Department of Economics and Sociology, Iowa State College, Ames, Iowa, on or before May 15, 1958.

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State duate All four members of the Subcommittee on Graduate Students' Contributed Papers participated in the judging of papers submitted by institutions on behalf of graduate students.

Recommendations for Awards for Graduate Student Contributed Papers

On June 17, 1958, Chairman A. Gordon Ball officially notified me that his Subcommittee recommended (in alphabetical order) the following awards:

To JOHN L. DILLON, of Iowa State College, for his contributed paper, "Theoretical and Empirical Approaches to Program Selection Within the Feeder Cattle Enterprise."

To PERETZ RAM, of North Carolina State College, for his contributed paper, "An Input-Output Analysis of a Small Homogeneous Agricultural Area."

To AKIRA UCHIDA, of Purdue University, for his contributed paper, "Technology Redefined—An Example of Quantitative Measurement in the Broiler Industry."

### 4. Award for Best Article in Journal of Farm Economics

As has been the practice for a number of years, the Editors and Editorial Council of the *Journal of Farm Economics* annually choose the most outstanding article published in that *Journal* during the preceding calendar year for an award, now valued at \$250. On July 2, 1958, I was officially notified by Robert L. Clodius, Editor of the *Journal*, that the article receiving the largest number of firsts and also the greatest point score was by:

HAROLD F. BREIMYER, of the Agricultural Marketing Service, U. S. Department of Agriculture, his *Journal* article being entitled "On Price Determination and Aggregate Price Theory," August, 1957, pp. 676-94.

William H. Nicholls, Chairman Awards Committee, AFEA

# MINUTES OF THE MEETINGS OF THE EXECUTIVE COMMITTEE, AFEA

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# WINNIPEG, AUGUST 21, 1958

Present: President Trelogan, Bressler, Brandow, Bachman, Penn, Clodius, Campbell, James, Cochrane, Brown, Sinclair, Doll, Kearl, Hardin.

1. The minutes of the previous three meetings of the Executive Committee were approved as published in the *Journal*.

2. The Secretary's report was accepted for presentation at the annual meeting.

3. Dr. Sinclair reported for the Local Arrangements Committee.

The report of the Investment Committee was accepted and recommended for presentation at the annual meeting.

5. James moved that the Executive Committee re-affirm the Association's operating policy of paying the travel expenses of appropriate speakers from other disciplines to participate in the annual summer meetings. The President has discretion to act on this matter. Carried.

6. Editor Clodius' report was accepted for presentation at the annual

7. Clodius moved that the proceedings of the 1958 annual meeting be published as a joint issue of the *Journal* with the Canadian Agricultural Economics Society. This carried with the understanding that Clodius was to handle the details.

8. Penn moved that the Executive Committee feels that the quality of the Proceedings Issue of the *Journal of Farm Economics* should be improved and that its size should be reduced. Consideration of this problem should be given by the total membership. Carried.

9. Doll reported on the Agricultural Hall of Fame as designated representa-

tive of the American Farm Economic Association.

Bressler moved that the Executive Committee authorize the President to appoint a delegate to represent the American Farm Economic Association in continuing contact with the Agricultural Hall of Fame. Carried. Raymond Doll was designated to continue in this responsibility.

10. President Trelogan indicated that Fellows in the Association will succeed to chairmanship of the Fellows Election Committee in the following order: Waugh, Hobson, Black, and Schultz. The President-Elect will appoint to this

committee a fifth Fellow from among the elected group.

11. Hardin reported that 204 invitations were extended to individuals to become corresponding members in our ICA contract program. Seventy-two have become corresponding members. It was further reported that the Association looks with favor upon expansion of eligible corresponding members to include agricultural economists in western Europe. Actual certification of eligible members is, of course, ICA's responsibility.

12. Sustaining membership activities were discussed and the excellent work of Ivy Duggan was recognized. Bressler will work out arrangements for this

program in the coming year.

13. Penn reported on the progress of the Student Activities Committee under the able chairmanship of A. Gordon Ball. It was moved that the AFEA continue to support at the present levels and in the present amounts: (a) the awards

program for papers submitted by graduate students, (b) the awards competition of \$75 to \$85 for winners of undergraduate competition, and (c) cost of issuing the Student Section AFEA Newsletter three times a year presently estimated at \$75; that methods and forms of undergraduate and graduate student competitions be continued unchanged. Carried.

14. The Awards Committee report prepared by Chairman Nicholls was made by Brandow and accepted for presentation at the awards program.

15. The Audit Committee report was accepted for inclusion in the annual

meeting agenda.

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16. The dues structure for joint memberships was discussed at some length by Committee Chaiman Penn. It was moved that joint memberships be continued with WFEA and CAES; that each Association would take a deduction of 50¢ on each joint membership. The resulting distribution of joint memberships would then become effective with 1959: net of \$8.50 to AFEA; net of \$1.50 to WFEA; and net of \$2.50 to CAES if the present rate is carried or net of \$4.50 if CAES dues are raised to \$5.00. Carried. Thus, joint memberships were not made available in other societies or associations.

17. Ebling presented the report of the Agricultural Data Committee for

inclusion in the published proceedings.

18. James reported for the Employment Committee in the absence of Chairman King. It was moved that this committee's activities be continued in the same fashion as it has operated in the last few years. Carried.

19. Trelogan reported on the successful 1957 winter meetings.

20. Bressler is completing arrangements for the 1958 winter meetings in Chicago where Howard Diesslin is handling local arangements for AFEA. Dates for the joint Allied Social Sciences meetings with headquarters in the Palmer House Hotel are December 27-30.

21. Penn reported as the AFEA representative to the Memphis Rural De-

velopment meeting last fall.

22. Trelogan reported that Henry L. Burkardt represented AFEA at the meeting of the American Academy of Political and Social Science. He further reported that P. L. Putnam will represent the Association at the workshop on agricultural meteorology at New Haven, Conn.

23. The functions of a possible business affairs representative for the Association were discussed at some length. Designation of the business responsibilities of the Association will be worked out by President Bressler and his Executive

Committee.

24. Trelogan reported that John D. Rush represented the Association at the President's Conference on Occupational Safety.

25. Harold G. Halcrow has been designated by the President as the AFEA representative on the Board of the National Bureau of Economic Research.

26. The matter of free reprints from the *Journal* was discussed. The present policy of no free reprints was sustained. However, the editor is to explore the cost of providing authors with a small number of free reprints.

27. The matter of providing emeritus professors with free memberships in

the Association was discussed but no action was taken.

28. Federal pay scales for certain classifications of scientists and for social

scientists in particular were reviewed. No action was taken.

29. Institutions indicating an interest in hosting the 1961 or later AFEA annual summer meetings include Texas, Colorado, Florida, Kentucky, Indiana, Wisconsin and Minnesota.

30. At present the Allied Social Sciences meetings are scheduled for Chicago, December 27-29, 1958 and Washington, December 28-30, 1959.

31. The meeting was adjourned at 5:00 P.M.

Respectfully submitted,

LOWELL S. HARDIN Secretary-Treasurer, AFEA

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# MINUTES OF THE ANNUAL BUSINESS MEETING, AFEA WINNIPEG, AUGUST 21, 1958

1. President Trelogan presented his report.

The report of the Secretary-Treasurer was presented and approved.
 The report of the Investment Committee was presented and approved.

4. C. D. Kearl, the Association's new Secretary-Treasurer, was presented to the membership.

5. Editor R. L. Clodius presented his report which was accepted.

6. R. L. Kohls presented the Audit Committee report which was accepted.

Bennett S. White presented the report of the Resolutions Committee.
 The resolutions were enthusiastically accepted.

8. R. A. King presented the report of the Employment Committee. 9. C. E. French presented the report of the Tellers Committee.

10. Bressler discussed plans for the Chicago meeting in December, 1958, and for the annual meeting at Cornell University, August 23-26, 1959. He also discussed the size and nature of the Proceedings Issue of the *Journal of Farm Economics*.

11. There being no further business, the meeting was adjourned.

Respectfully submitted,

LOWELL S. HARDIN Secretary-Treasurer, AFEA

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